FUNCTIONAL OUTCOME OF UNSTABLE PELVIC FRACTURES

A RETROSPECTIVE STUDY

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In partial fulfillment of the requirements for the award of

MASTER OF SURGERY

(BRANCH II, ORTHOPAEDIC SURGERY) DEGREE

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CERTIFICATE

This is to certify that this dissertation, "**FUNCTIONAL OUTCOME OF UNSTABLE PELVIC FRACTURES - A RETROSPECTIVE STUDY**" is an original work of research done by Dr. Anton Job Romesh Prasad, towards partial fulfillment of the requirements for the award of MASTER OF SURGERY (Branch II, Orthopaedic Surgery) Degree.

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In the words of Sushruta "*Surgery is the first and the highest division of the healing art, pure in itself, perpetual in its applicability, a working product of heaven and sure of fame on earth*". I thank God for giving me this opportunity to learn the art and science of Orthopaedics, without whom I would not be here today.

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Anton Job Romesh Prasad

Date:

INDEX

Aims:

To assess the functional outcome of unstable pelvic fractures.

Objectives:

To evaluate functional outcomes using Majeed Score and Iowa Pelvic Score.

To evaluate the morbidity.

To evaluate the psychological and psychosomatic status using SF 36 General Health Outcome Survey in patients treated for completely unstable pelvic injuries (Tile class B & C).

Introduction:

Pelvic fractures account for approximately 1 to 3 percent of all skeletal fractures and are the reason for approximately 2 per cent of admissions to the hospital for orthopaedic treatment [33]. In polytrauma, pelvic ring injury is present in 20% of cases [22]. The frequency of pelvic fractures has a bimodal pattern, with peaks in the second, third, and fourth decades of life and then in patients older than sixty-five years [21]. The fractures range in severity from relatively benign avulsions to massive fracture dislocations with complete pelvic disruption.

Most of the injuries are stable. These types of fractures are frequently the result of a low-energy injury, and they occur either in younger patients, who sustain avulsion of a tendon-bone complex (most commonly the anterior superior iliac spine, the anterior inferior iliac spine, or the ischial tuberosity) from the pelvis during an athletic activity, or in elderly patients who have fallen from a standing position. Most low-energy pelvic fractures are relatively easy to treat with rest, analgesics, and stretching, until the patient's discomfort has abated sufficiently to allow resumption of normal activities.

In contrast, pelvic fractures that are produced by moderate or high-energy force (particularly during a motor-vehicle accident)

usually are associated with substantial soft-tissue injuries on other skeletal lesions that complicate assessment, stabilization, and definitive treatment.

Stability may be defined as the ability of the pelvis to withstand physiological forces without displacement. A pelvic fracture reflects only a portion of the destructive energy sustained by the patient and is a marker for the associated soft-tissue injuries[3]. Of particular concern are the high-energy forces sustained in pedestrian-motor vehicle accidents. Such accidents account for many deaths of patients who sustain a pelvic fracture, although they are the cause of injury in a far smaller percentage of patients who have sustained a pelvic fracture.

The force vectors causing pelvic fractures have been well elucidated and correlated with the fracture pattern [42].

Fracture can be Stable,

Rotationally unstable but vertically stable or

Unstable both rotationally and vertically.

These varying patterns must be evaluated separately to assess their inherent differences. One would expect that the more unstable an injury is, the greater the accompanying soft tissue injury will be. With more disruption of the pelvic ring and ligaments, greater morbidity has been seen. Treatment includes initial stabilization followed by bed rest augmented by traction or

pelvic sling [11], external fixation with or without traction, and anterior or posterior internal fixation [17].

A thorough knowledge of the anatomical structures contributing to pelvic stability is essential to the assessment and treatment of these injuries. The anatomy of the pelvic ring has been described in brief and the emphasis is on the weight-bearing posterior structures.

Over the last decade, there has been considerable interest in the importance of assessing medical and surgical outcomes [15]. There is now a broad array of outcome measures for evaluating the efficacy of therapeutic agents or procedures [2]. Clinical results of operative treatment of pelvic injury are difficult to assess objectively.

Traditionally results of pelvic injuries have been judged in terms of how closely the result approaches the fundamental objective of prolongation of life, relieving distress, restoring function, preventing disability and fracture union rates [15,30,39]. Patient-oriented clinical outcome research, however, goes further and gives an objective insight into what patients are able to perform and how they feel emotionally. They not only take into consideration the presence of physical symptoms but also the emotional aspect of injury which can significantly influence recovery and hence the outcome of the injury and the treatment

given, by speeding or slowing recovery and return to pre morbid status.

Anatomical considerations of the pelvis:

The pelvis is comprised of a *bony ring* made of the sacrum and the two innominate bones. The innominate bone is formed from the fusion of three ossification centers: the ilium, the ischium, and the pubis [16, 29] .These ossification centers join at the triradiate cartilage of the acetabulum and, when fused, form a complete, innominate bone or hemipelvis. The centers that form the hemipelvis meet *anteriorly* at the public symphysis, where they are united by a fibrocartilaginous interpublic disc, reinforced above by the superior public ligament and below by the arcuate pubic ligament. Additional anterior support is provided by the anterior abdominal wall. The internal oblique and transversus abdominis muscles take origin from the lower ribs and the iliac crest and insert via a fascial aponeurosis into the rectus abdominis sheath, and into the pubic tubercle as the transversalis fascia. The inguinal ligament (the reflected portion of the external oblique aponeurosis), which runs from the iliac crest and anterior superior iliac spine to the pubic tubercle, also provides soft tissue support to the pelvis.

In the *posterior pelvic ring*, the innominate bones articulate with the sacrum. The sacrum is roughly triangular in shape when viewed in the frontal plane and trapezoidal when viewed in an axial projection. The configuration of the sacrum reflects its mechanical role in transmitting load from the axial skeleton to the lower extremities. Tile[42] compared the sacrum with the keystone of an arch in that an axially applied load increases the stability of the articulation between the hemipelvis, the sacrum, and the lumbar spine. The sacrum itself is typically composed of the fusion of five sacral segments. Occasional incorporation of six segments into the sacrum (sacralization of L5) can be seen either unilaterally or bilaterally .

The sacroiliac joint is the major articulation between the sacrum and innominate bones. This joint has a relatively small synovial cavity between two large articular surfaces . The articular surface of the sacroiliac joint is irregular in contour, which contributes to its intrinsic stability. The strong posterior ligamentous complex provides the majority of the mechanical stability to the pelvis

The *interosseous ligaments*, which originate from the internal surface of the iliac wing posterior to the sacroiliac articulation and run to the dorsal surface of the sacrum, are thought to be primary

stabilizing ligaments of the sacroiliac joint. Superficial to the interosseous ligaments are a series of connecting ligaments that join various portions of the pelvic ring together. These include the short and long posterior sacroiliac ligaments. The short posterior sacroiliac ligaments are oriented nearly horizontally and pass between the posterior tuberosity of the ilium and the posterior spinous processes of the sacrum. The long posterior sacroiliac ligaments are oriented longitudinally and blend with the fibers of the sacrotuberous ligament. More ventrally, the anterior sacroiliac ligaments represent the anterior part of the fibrous capsule of the sacroiliac joint. This fibrous membrane is thin and relatively weak.

The *pelvic floor* is supported by the sacrotuberous and sacrospinous ligaments that contribute to the posterior, superior, and rotational stability of the pelvic ring (Fig 1). The sacrotuberous ligament originates in three locations: from the dorsal surface of the lower three sacral vertebrae; from a posterior portion of the

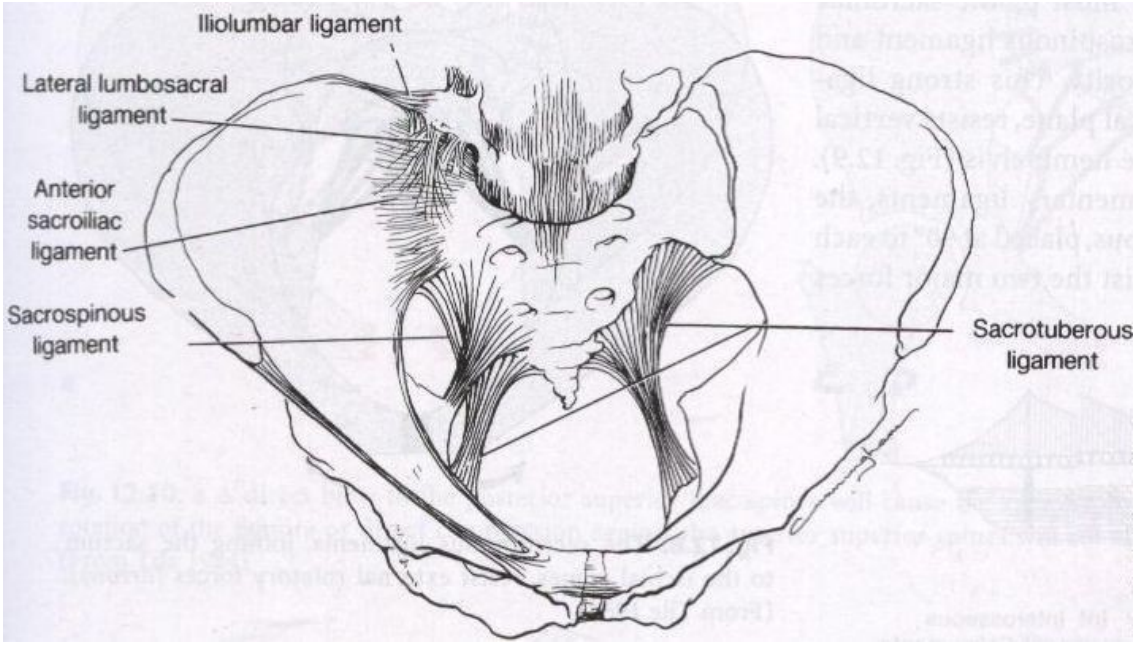


Figure 1

iliac crest in the region between the posterior superior and the posterior inferior iliac spines; and from the long posterior sacroiliac ligaments. From these origins, the fibers run laterally and inferiorly to form a strong ligamentous attachment at the medial border of the ischial tuberosity. The medial portion of this attachment of the tuberosity blends with the obturator internus membrane as the falciform process. The sacrospinous ligament is thinner and narrower than the sacrotuberous ligament (Fig 2). It is triangular, originates on the lateral border of the sacrum and coccyx, and inserts on the ischial spine. The sacrospinous ligament divides the posterior pelvis into the greater sciatic foramen and lesser sciatic foramen (Fig 3). The pudendal nerve courses posteriorly over the

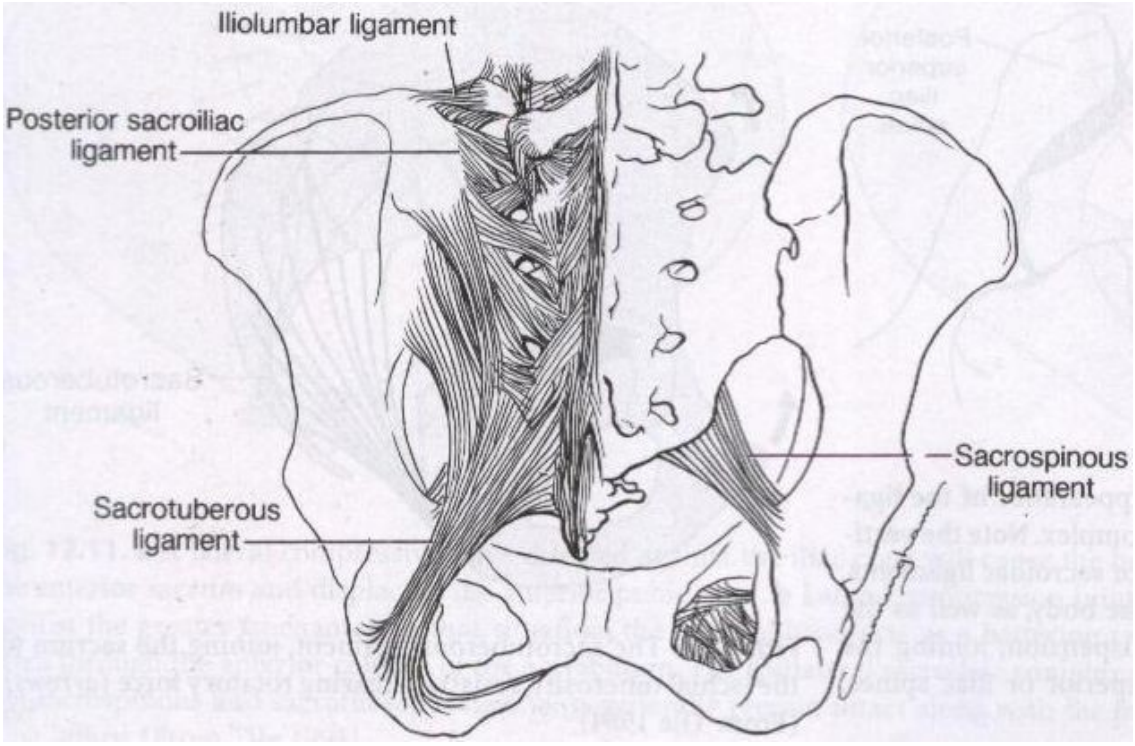


Figure 2

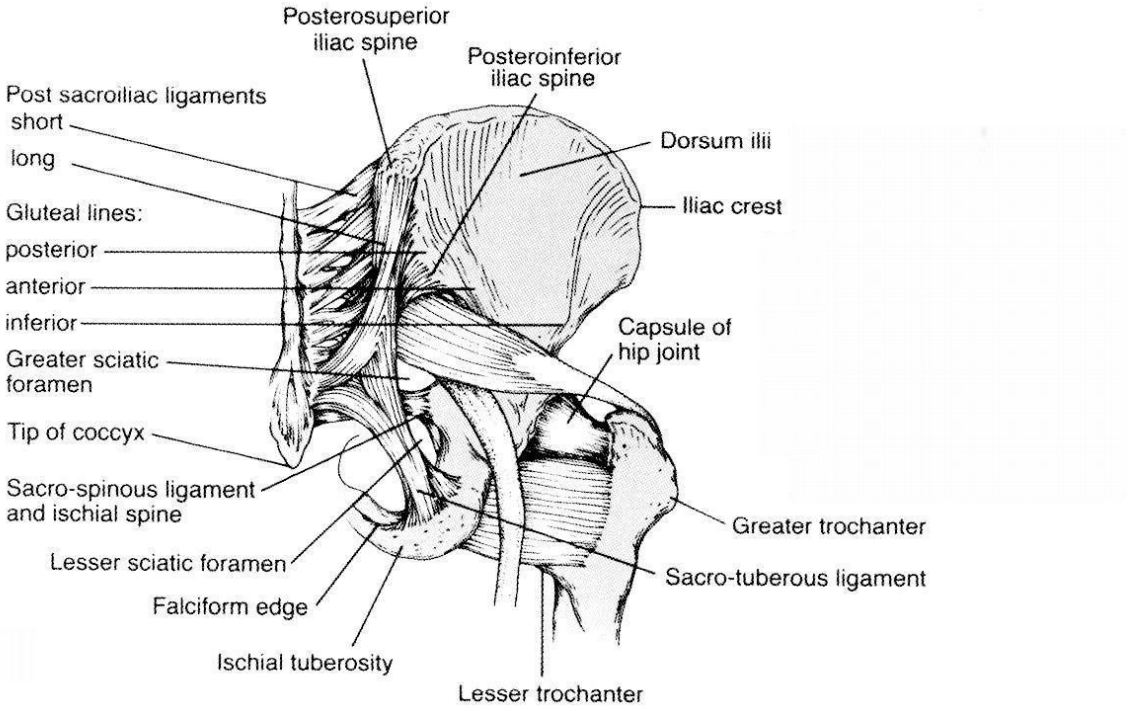


Figure 3

sacrospinous ligament after exiting the greater sciatic notch to enter the lesser sciatic notch where it courses along the inferior pubic ramus before exiting into the perineum. The anterior surface of the sacrospinous ligament blends with the coccygeus muscle, and it has been said to represent a degenerated posterior part of the muscle belly itself.

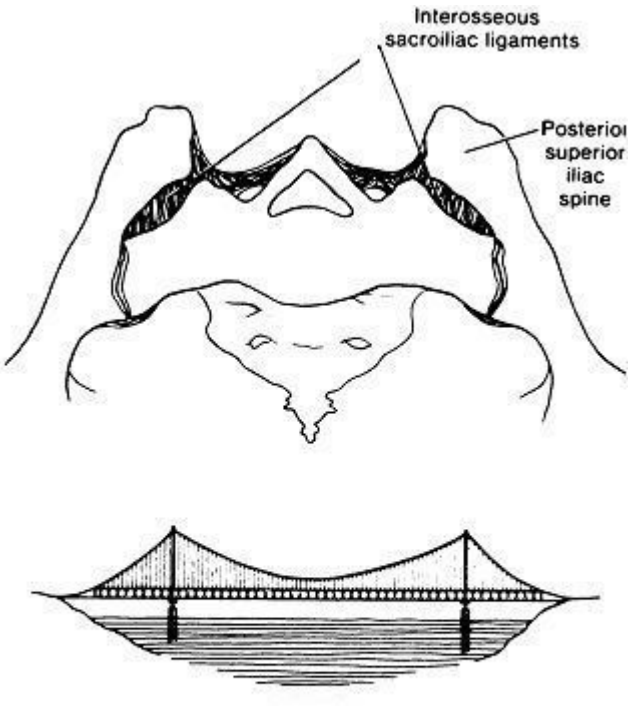
Superiorly, the iliolumbar ligament arises from the transverse process of the fifth lumbar vertebrae and extends to insert on the inner surface of the ilium just anterior to the sacroiliac joint, blending with the anterior sacroiliac ligaments. With superior or lateral displacement of the hemipelvis, strain on this ligament often results in avulsion fractures of the fifth lumbar transverse processes. These fractures serve as radiographic markers for the severity of the injury.

Mechanism of fracture:

Pelvic Biomechanics:

1. The pelvis is a *ring structure,* and if the ring is broken in one area and the fragments displaced, then there must be a fracture or dislocation in another portion of the ring.
2. *Stability* may be defined as the ability of the pelvis to with stand physiological forces without displacement. The *stability* of the pelvic ring depends upon the integrity of the posterior weight-

bearing sacroiliac complex, with the major sacroiliac, sacrotuberous and sacrospinous ligaments. The extremely strong posterior sacroiliac ligaments maintain the normal position of the sacrum in the pelvic ring and the entire complex has the appearance of a suspension bridge (Fig. 4). The sacrospinous ligaments join the lateral edge of the sacrum to the ischial spine and resist external rotation of the hemipelvis, whereas the sacrotuberous ligaments resist both rotational forces and shearing forces in the vertical plane.



The ligaments binding the posterior sacroiliac complex. The interosseous sacroiliac ligaments, the strongest in the body, are aligned vertically. The transverse components act as the tension members in a suspension bridge, and join the pillars of the posterior superior iliac spines to the sacrum

Figure 4

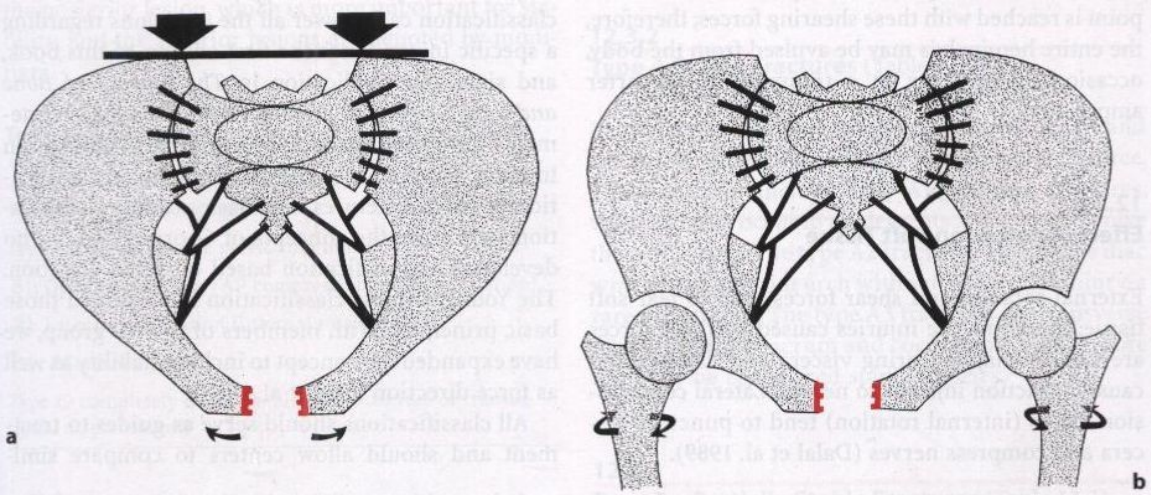
3. The major forces acting upon a hemi-pelvis are

- External rotation (also called anteroposterior compression),

- Internal rotation (compression from the lateral side) and
- Shear or Translational forces in the vertical plane.

In some complex high energy injuries, the forces may defy detailed description.

External Rotation forces occur with a direct blow to the posterior superior iliac spine or more commonly, by forced external rotation through the hip joints unilaterally or bilaterally. The force usually produces an open book injury (Fig 5).



a A direct blow to the posterior superior iliac spines will cause the symphysis pubis to spring open. **b** External rotation of the femora or direct compression against the anterior superior spines will also cause springing of the symphysis.

Figure 5

The forces of internal rotation or lateral compression may be transmitted by a direct blow to the iliac crest causing an upward rotation of the hemipelvis (bucket handle fracture), or through the femoral head causing an ipsilateral injury (Fig 6).

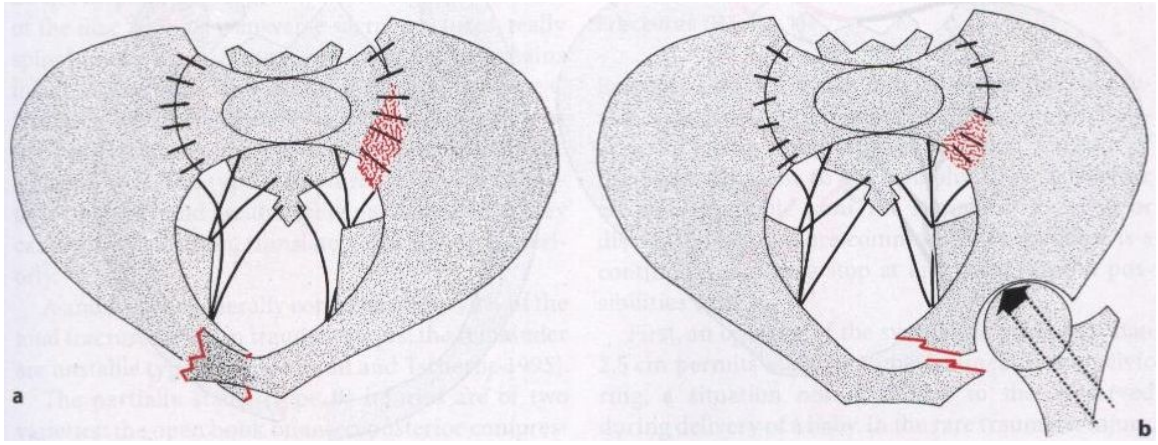
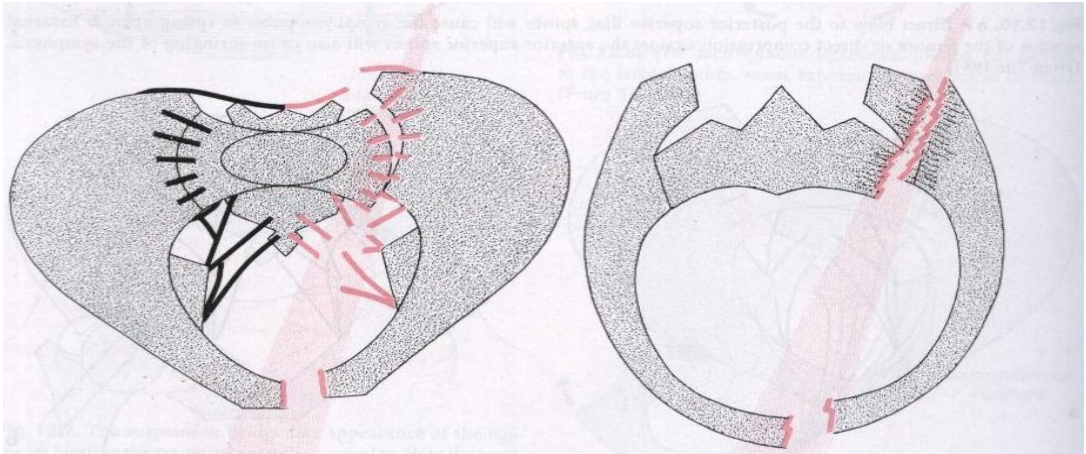


Figure 6

Shearing forces in the vertical plane cross the main trabecular pattern of the posterior sacroiliac complex, whereas a lateral compressive force causes impaction of the cancellous bone and usually allows retention of the ligament integrity. However the external rotation and the lateral compression forces may be so great that they can overcome this ligamentous restraining effect causing and unstable pelvic fracture (Fig 7). No finite point is reached with these shearing forces, therefore, the entire hemipelvis may be avulsed from the body, occasionally resulting in traumatic hindquarter amputation [12].



A shearing force *(arrows)* crosses perpendicular to the main trabecular pattern of the posterior pelvic complex in the vertical plane. These forces cause marked displacement of bone and gross disruption of the soft tissues, resulting in major pelvic instability. (From Tile 1995)

Figure 7

The pelvic arcade:

The trabecular pattern of the pelvic arch is continued down into the calcar femorale (Fig. 8 & 9). Not only is there a central arch whose summit is formed on each side by the sacrum, but also this central arch is flanked by two additional arches formed by the side wall of the pelvis between the acetabulum and the anterior superior iliac spine, and by the ilio-tibial tract with the gluteus medius and minimus down to their femoral attachment. An arcade structure thus exists, perfect for carrying the load that the trunk imposes upon it, and for transmitting this load to the legs which are its columns.

Pelvic fractures in general can divided into two major types based on the amount of energy involved a) low-energy fractures which results in fractures of the individual bones b) high energy fractures which causes pelvic disruptions.

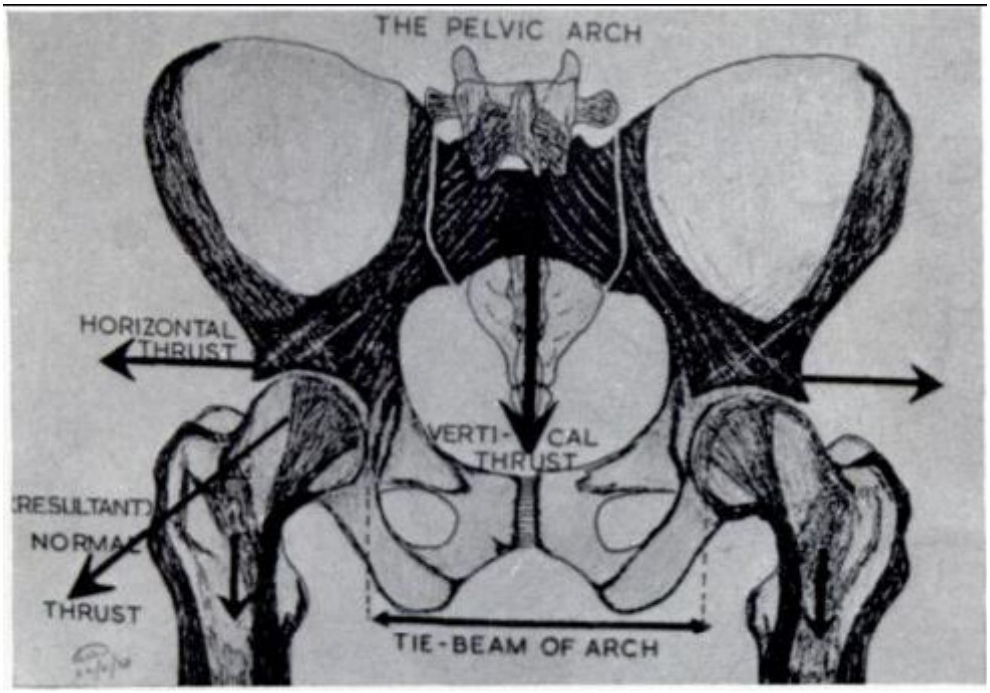


Figure 8

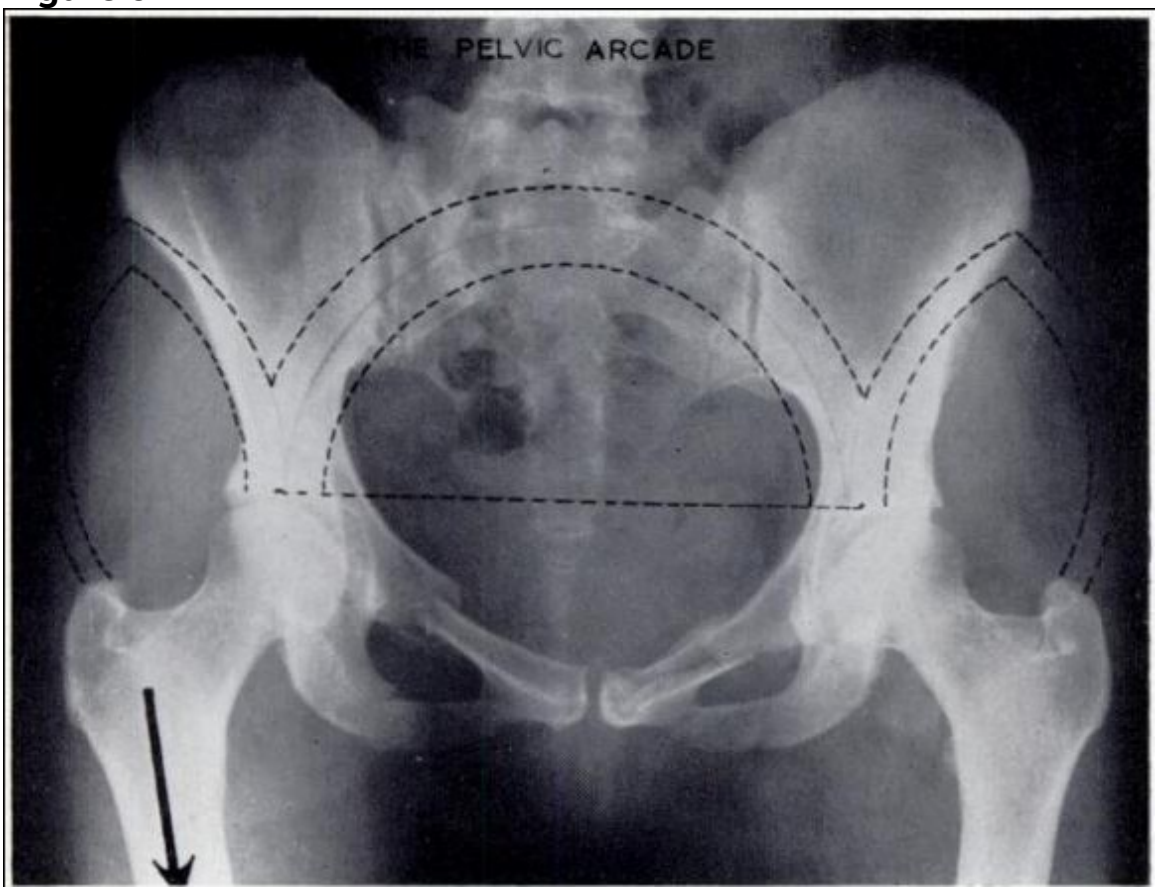


Figure 9

Low energy fractures:

a) Domestic falls - common among elderly population .

b) avulsion fractures of the muscle apophyses in immature patients, sports injuries - anterior superior and inferior spines and the ischial tuberosity in young athletes. Iliac wing fratures – lateral impact.

High energy fractures:

These are more severe and are associated with soft tissue and visceral injuries. These may be road traffic accidents, fall from height, crush injury, ejection injury, and penetrating missile injury.

Classification of Pelvic Fractures:

The ideal pelvic injury classification system would facilitate injury identification, aid in the prediction of morbidity in terms of associated injuries, form the basis of treatment decisions, and allow interstudy comparison of treatment and outcome. In 1972 Huitten and Slatis[41] associated mechanism of injury with bony and visceral trauma. In 1980 Pennal associates and Tile[42] described disruption of the pelvic ring in terms of the direction of the deforming force applied to the pelvic ring and sub classified pelvic fracture into Lateral Compression (LC), Antero Posterior Compression (APC) and Vertical Shear (VS) injuries They focused attention on the fact that reproducible patterns of ring disruption could be expected even when the direction of force or mode of injury is unknown.

Bucholz [4] reported the findings at autopsy of patients with pelvic ring injuries who died of associated trauma. His findings provide a clinical correlation to the bench top tests performed by Tile [43]. Both Tile and Bucholz have proposed classification systems describing three basic categories of pelvic ring injury:

(1) Stable pelvic ring with isolated pubic symphysis disruption, or pubic rami fractures without other ligamentous or displaced bony injuries. Bucholz noted that isolated pubic rami fractures are frequently accompanied by an impacted or undisplaced sacral fracture.

(2) Rotationally unstable pelvic ring injuries with either internal or external rotation deformities of the hemipelvis relative to the sacrum.

(3) Rotationally and vertically unstable injuries. Vertical instability refers to disruption of the anterior and posterior pelvic ring allowing potential displacement posteriorly, superiorly, and in sagittal plane rotation (flexion), in addition to rotation in the horizontal plane (internal or external rotation). The Tile classification has designated these categories from least severe to most severe as Types A, B, and C (Fig 10).

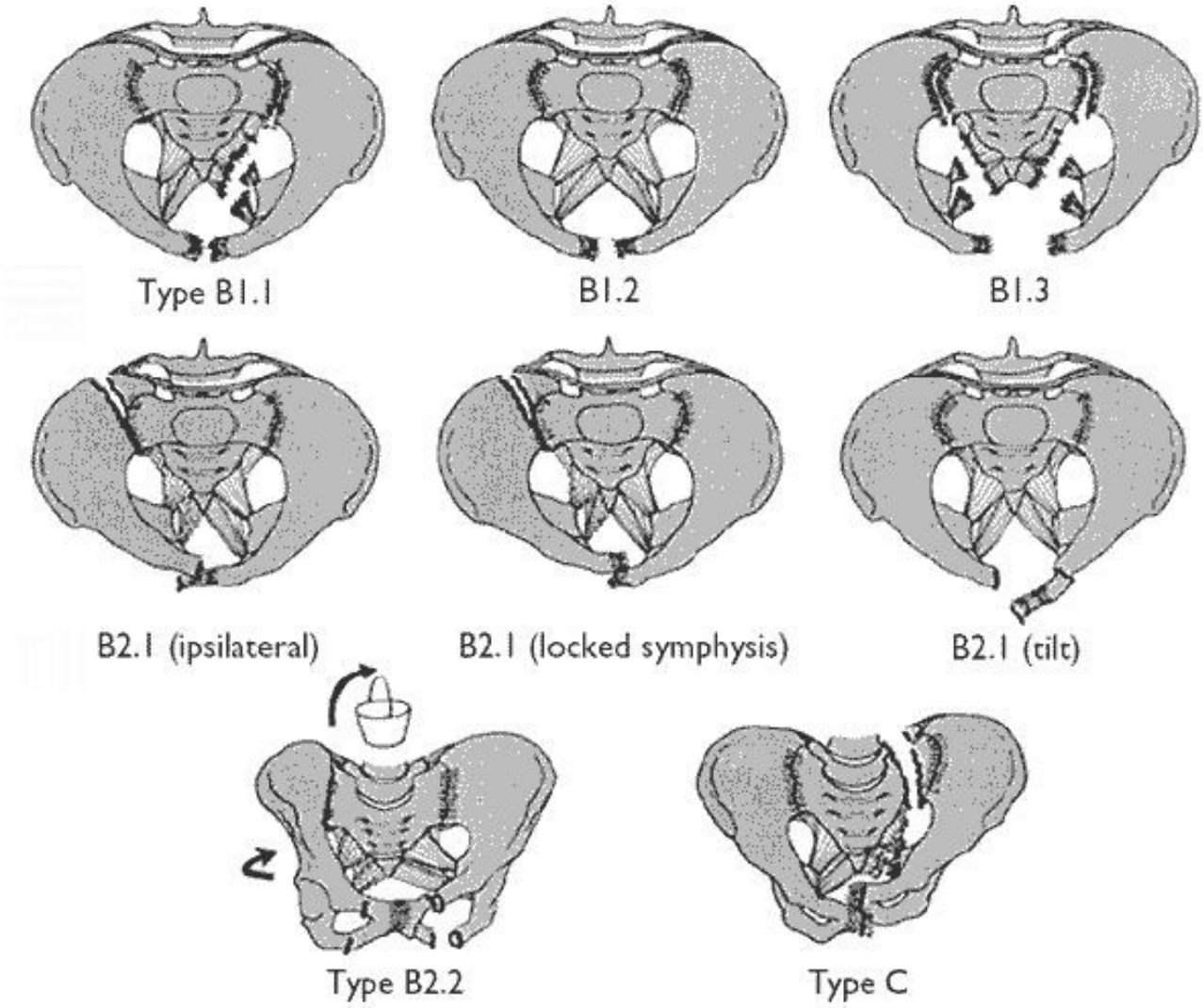


Figure 10

Letournel suggested a classification of pelvic ring injuries based on the anatomic site of injury (Fig 11). The sites of injury were divided into anterior and posterior pelvic ring locations [29].

Anterior ring injuries included:

(1) pure symphysis pubis diastasis.

(2) vertical fracture lines dividing the obturator ring or adjacent body of the pubis.

(3) acetabular fractures.

Posterior pelvic ring injuries were characterized as:

(1) transiliac fractures not involving the sacroiliac joint.

(2) fracture dislocations of the sacroiliac joint with the bony injury extending either through the sacrum or through the iliac wing (the so called crescent fracture)

(3) pure sacroiliac joint disruption

(4) transsacral fractures.

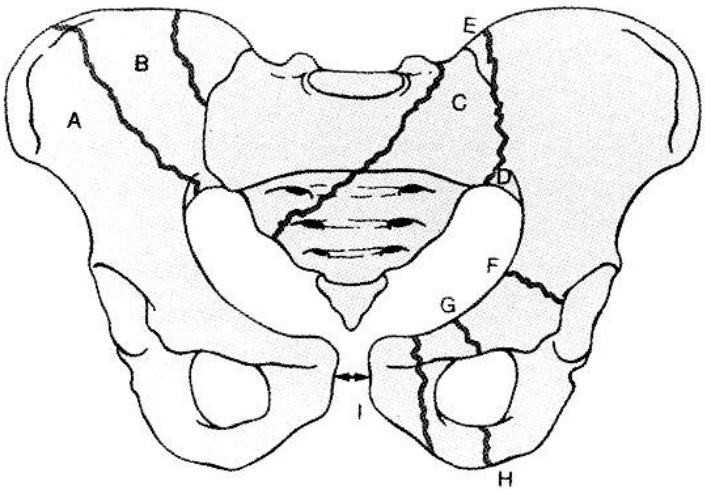


Figure 11

Letournel classification of pelvic ring injuries.
This classification system provides an anatomic description of the site of pelvic ring disruption.
Posterior ring injuries, A-E:
(A) transiliac wing fracture;
(B and E) fracture dislocation of the sacroiliac joint (crescent fracture);
(C) sacral fracture;
(D) sacroiliac joint disruption. Anterior ring injuries,
F-I: (F) acetabular fracture;
(G and H) superior and inferior pubic rami fractures;
(I) pubic body fracture, or pubic symphysis disruption

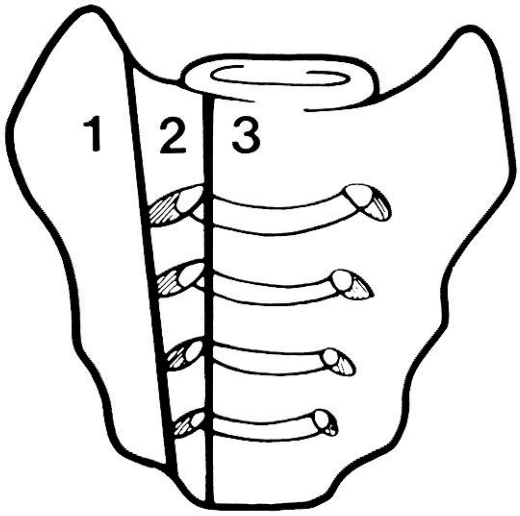


Figure 12

Dennis et al [7] further characterized sacral fractures based on the anatomic region within the sacrum (Fig 12).

Zone 1, injuries to the sacral ala lateral to the sacral foramina that do not cross the sacral foramina or sacral body.

Zone 2, fractures extending into the sacral foramina that may begin in the sacral ala and extend to the foramina

Zone 3, fractures that extend into the central body of the sacrum and that can be vertical, oblique, or transverse and cross the sacrum in any number of patterns, all of which involve the sacral body and canal.

The classification has proved very useful in predicting the presence of associated neurological injuries with sacral fractures.

Young and co-workers refined the pelvic ring classification using general subsets as described by Pennal et al. They divided LC & APC fractures into subsets I,II, & III

Injury classification keys according to the Young system:

Category Distinguishing characteristics

LC Tansverse fracture of pubic rami, ipsilateral or contralateral to posterior injury

I – Sacral compression on the side of impact

II – Iliac wing fracture on the side of impact

III – LC I or LC II injury on the side of impact; contralateral open book (APC) injury

APC Symphyseal diastasis or longitudinal fractures

I – Slight widening of the pubic symphysis or the anterior SI joint, Stretched but intact anterior SI, Sacrospinous, Sacrotuberous ligaments, intact posterior SI ligaments.

II – Widened anterior SI joint, disrupted anterior SI, Sacrospinous, Sacrotuberous ligaments, intact posterior SI ligaments.

III – Complete SI joint disruption with lateral displacement, disrupted anterior SI, Sacrospinous, Sacrotuberous ligaments, disrupted posterior SI ligaments.

VS Symphyseal diastasis or vertical displacement anteriorly and posteriorly, usually through the SI joint, occasionally through the Iliac wing or sacrum.

CM Combination of other injury patterns, LC/VS being the most common. CM – Combined Mechanical

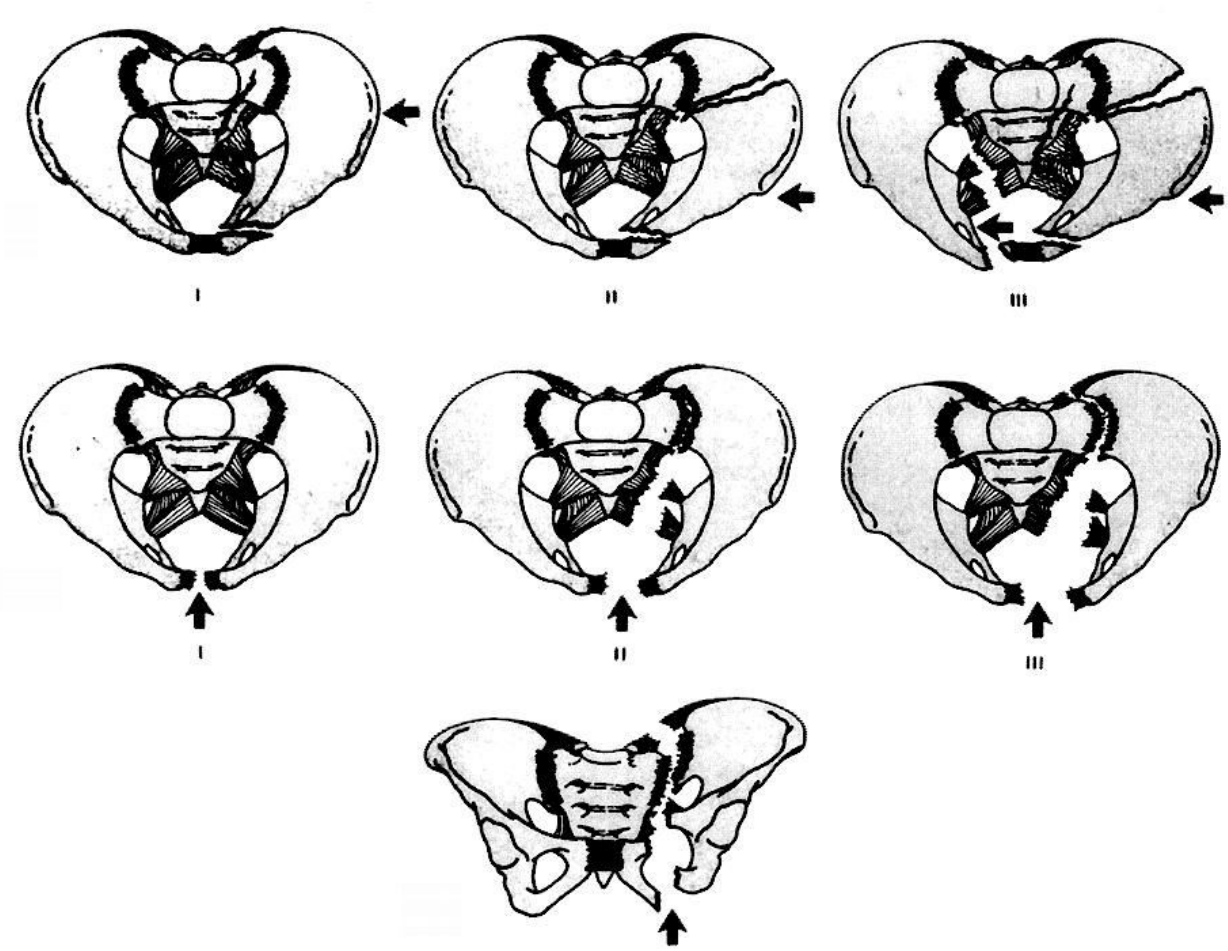


Figure 13

Classification of pelvic ring disruption (Tile 1988)

Comprehensive Classification	Young & Burgess equivalent
Type A Stable pelvic ring Injury	No equivalent
A1 Avulsion of Innominate bone	No equivalent
A2 Stable iliac wing fracture	
Minimally displaced ring fracture	No equivalent
A3 Transverse fracture of the sacrum coccyx	No equivalent
Type B Partially stable	
B1 Open book injury	APCI APC II
B2 Lateral compression injury	LCI LCII Crescent
Bucket handle type	fracture
B3 Bilateral B injuries	Windswept complex
Type C Complete unstable	
C1 Unilateral SI joint fracture dislocation	APCIII, Vertical shear
C2 Bilateral one side B one side C	Complex
C3 Bilateral rotationally and vertically unstable	Complex

Review Of Literature:

Fracture stabilisation before the 19th century was in its infancy. The outcome was suboptimal, and quite often mortality was the end result. Advances in the stabilisation of long-bone fractures did not become apparent until the mid-1940s and for other bones, even later. In the mid-1960s, Judet and Letournel initiated a series of experimental and clinical studies focusing on pelvic and acetabular reconstruction surgery. Their work set the pace for all the subsequent advancements made in this field of

surgery. Today, pelvic and acetabular reconstruction is a recognized subspecialty within the disciplines of trauma and orthopaedics [34].

In the 600-500 BC in India there were many well-known physicians, but Sushruta [8] was considered the father of surgery. He made great improvements in the techniques of abdominal surgery, obstetrics, gynaecology, plastic surgery and orthopaedic surgery. One of the most important principles of his teachings was: "*Surgery is the first and the highest division of the healing art, pure in itself, perpetual in its applicability, a working product of heaven and sure of fame on earth*". In his Sushruta – Samhita text book of surgery he describes his innovative principles in the treatment of hip dislocation and fracture-dislocation, involving traction, pressure, compression and bandaging. This system was used not only for the acute reduction of fracture dislocations and simple dislocations, but also in the continuing nursing care of the patients.

Hippocrates' (460 – 377BC) medical observations and works are found in the collection *Corpus Hippocraticum*. His references to orthopaedics and traumatology are contained in three texts: on fractures, on joints and on *mochlikon* (instruments of reduction).

Ambroise Pare (1510—1590) is considered as the founder of modern surgery and a pioneer of orthopaedics. In 1554 he published the monumental anatomical text Human anatomy. His

last book, A. Pare's works, was published in 1575 (translated into English in 1678)

The first written description of pelvic fractures was by Duverney in 1751. He detailed the iliac fracture, now known as Duverney's fracture, of a patient who eventually died from sepsis [9].

Before the introduction of radiography, J.F. Malgaine (1806—1865) described pelvic fractures in Paris. In 1847 he published an atlas of traumatology in which he characterised ten patterns of ramus fractures with a vertical fracture of the iliac bone (Malgaine injury).

In the same era, Sir Ashley Cooper (1768—1841), a British surgeon named by Rawling, described the same fracture.

The application of radiology in orthopaedics helped many authors to diagnose and treat pelvic fractures. Rankin in 1937 and Watson-Jones [45] in 1938 reported on the conservative management of pelvic fractures.

Until the 1950s, only conservative treatment of pelvic fractures was possible. Bed rest, compression devices together with plaster and immobilisation, extensions or slings and closed reposition were all used.

However, even before the 1950s there were some ''brave'' surgeons who performed pelvic osteosynthesis. Albin Lambotte (1866—1955), a Belgian, was one of several surgeons who

operated on the pelvis in the first years of the 20th century. He used cerclage wire for pubic symphysis disruption and sacral bars for sacroiliac joint dislocation. He also recorded a retrograde screw fixation of pubic ramus fractures. A similar technique of sacroiliac screw fixation was described later by Lehmann (1934) and Meyer-Burgdorff (1936). Smith-Peterson (1921) and Holdsworth (1948) [11] proposed arthrodesis of the sacroiliac joint for painful sacroiliac conditions.

George F. Pennal [31] (1913—1976) investigated the effect of anteroposterior compression, lateral compression and vertical shearing forces on the pelvic ring. He has also introduced inlet and outlet radiographical projections, and pioneered the early use of the external fixator for multiply injured patients. His work on the mechanics of the pelvis led him to a classification of pelvic injuries which was later modified by M. Tile, and was the basis of the Young- Burgess classification.

M. Tile continued and improved on Pennal's work on the management of pelvic fractures. He published many articles on pelvic injuries and a classic text titled *Fractures of the pelvis and acetabulum*.

External and internal fixation:

Carabanola [34] (1973) first presented his positive experience with external fixation in a larger group of patients. Slatis and Kara-

harju (1975)[38] published data on the biomechanical behaviour of a trapezoid frame, which produced compression in the dorsal pelvis. However, some biomechanical and clinical disadvantages of external fixation were quickly recognized; biomechanical studies by McBroom and Tile (1982) [21], revealed the shortcomings of any external device. Today, an external device is mainly a temporary measure, while waiting for the opportune moment to internally fix the unstable pelvic ring. Now internal fixation is the mainstay of treatment of unstable pelvic ring injuries.

The minimally invasive techniques first described by Matta [20] in 1989 are becoming popular with many surgeons. In his study of 54 patients with a 15 month average follow up, he described the method of fixation of anterior ring disruption, fixation of individual fractures and an accurate posterior sacroiliac joint reduction and internal fixation.

Assessment of outcome:

The assessment of out come after a pelvic fracture based on the intervention had been done for decades.

Richardson et al (1982) assessed results solely on the basis of returning to work [35]. He reported 50% mortality rate, associated injuries and noted his observation of early management of pelvic trauma and outcome.

Ward, Thomasin and Vander Griend [44] (1987) used walking ability as the main functional parameter. They published their work, in which they noted the treatment of displaced hemi pelvis by open accurate reduction an internal fixation of the posterior ring and internal or external fixation of the anterior ring.

Further as a parameter to measure the outcome Slatis and Karaharju [40] (1980) used impaired gait and persistent pain in the sacro-iliac region, Shepherd [39] (1954) stressed the need for an "assessment that is comprehensive, generally applicable and reliable". Numerical scoring systems were used for the functional assessment of the hip, Judet and Judet[13] in 1952, Merle 'Aubigne and Postel [24] in 1954 and Lazansky[18] 1967; and Mc Broom and Tile [19] demonstrated the use of Iowa Pelvic score.

Van Gulik et al in 1987 published a study of 15 patients with type C injury treated conservatively with pelvic sling and skeletal traction. They showed results which suggested a more favourable perspective of the conservative management of pelvic ring disruptions than generally assumed [44].

A system for assessment of function after major pelvic injuries was proposed by S.A Majeed (1989) [19]. Five factors were assessed and scored: pain, standing, sitting, sexual intercourse and work performance. The total score then gave a clinical grade as excellent, good, fair or poor. The scoring system allows

comparison between early and late results and also between various methods of treatment.

Michael A. Miranda et al (1996) [26] did a prospective study involving 53 patients. He showed the results of a protocol based treatment of selective fractures using external fixator with a 5 year follow up. He used SF36 General Health survey and Iowa pelvic scores. He concluded that the results of non operative, open reduction and internal fixation and intermittent use of external fixation to treat pelvic injuries were remarkably similar and the restoration of traumatically displaced anatomy should maximize long term results.

Holdsworth [11] reported on 50 pelvic ring disruptions treated with 12 weeks in a pelvic sling with or without traction. He found that Sacro Iliac dislocations had poorer outcomes than sacral or iliac fractures.

One of the widely quoted series of pelvic fractures is from Slatis and Huittinen [41]. Of 163 patients, 113 were treated with bed rest and light pelvic sling for six weeks. Only 30 patients had type III injury through the Sacro Iliac joint. 65 patients were observed for one to seven years. Major complaints included pelvic obliquity and impaired gait, lumbosacral nerve deficit and disabling low back pain.

Paul Tornetta [30] in his study in operatively treated unstable posterior pelvic ring disruptions in 46 patients had 63% patients returning to normal activity of which 35% having significant neurological deficits which affected the final result. Thus concluding that properly performed internal fixation yielded good result.

J. Dean Cole [6] et al in his study of unstable posterior pelvic ring injuries compared patients with SF36 scoring system and statistically showed that patients with posterior ring trauma did worse than the ones without. And compared the different modes of treatment and how it affected outcome and also proposed his own 40 point scoring system.

This study evaluates the outcome of unstable pelvic injuries treated in our hospital.

Materials and Methods:

This is a retrospective study done in Christian Medical College, Vellore, on data collected on patients who were admitted between January 2000 and January 2007 in our hospital. 141 patients were treated in our Accident & Emergency services for pelvic fractures. Of them eight people had died. The causes were as follows, one patient had died of meningitis, one died due to injuries caused by train run over, and six due to road traffic

accident injuries. 41 patients who were admitted for treatment were of type B and C, they met the study criteria.

The inclusion criteria was;

All patients with Tile type B and C.

The exclusion criteria was:

1. Residual traumatic cognitive defect
2. Acetabular fracture
3. Spine injuries with neurological deficit
4. Repeat trauma
5. Inadequate radiograph to classify the fractures

Invitations was sent for follow up. Seven letters returned with address unknown. The study comprised of 23 patients (57.5%), who came for follow up for this study.

The 23 include 17 men and 6 women. The mode of injury was

a) Road traffic accident which included, bicycle vs. four wheeler, two wheeler vs. four wheeler, vehicle tyre run over and thrown over board, which was 14 men and three women

b) Crushing injury sustained due to wall collapse and bullock cart run over, which included one man and two women.

c) Fall from height, which was fall from a tree and fall into a well, which included two men and a woman

Using pelvic injury classification system

Tile B 14 (60%) had eleven men and three women, and

Tile C 9 (40%) had six men and three women.

The mean age at injury was 33.1 years (4 - 60years).

The mean follow up time was three years and six months (9 months – 88 months).

All patients were initially assessed and managed according to Advanced Trauma Life Support protocols [1].

The outcome of the patients were assessed as follows

1.Standard questionnaire

2.Pelvic fracture classification - Tile classification;

3.Severity of trauma -- Injury Severity Score (ISS);

4.Functional outcomes – Majeed Outcome Scale, Iowa Pelvic Score[20];

5.Psychological and Psychosomatic status – Short Form 36 Health Survey.

6.Physical examination

7.Plain Radiography.

For the 23 patients the following treatment was done (table 1). Three people were treated with external fixator, two underwent pubic symphysis plating, one ilial plating, one posterior sacroiliac screw fixation, three were treated with skeletal traction, one with

spica and thirteen with bedrest. The patient treated with spica was a four years old girl who also had a subtrochanteric fracture. Totally seven patients were operated. While analyzing the patients who underwent surgery according to Tile type, of the 14 patients in Tile B three were operated and of the nine in Tile C four were operated. There were three patients treated with skeletal traction, two were in Tile B group and one in Tile C group.

Table 1: Methods of treatment

	Numbers
External Fixation	3
Anterior plating (Symphysis)	2
Ilium Plate	1
Posterior screw	1
Skeletal traction	3
Spica	1
Bed rest alone	13

The patients on skeletal traction were treated for six weeks. All the patients had 6 weeks of bed rest and further six weeks of non weight bearing crutch walking except two. There was one male with both lower limb fracture hence could not walk for three months and a child treated who was treated with spica and had good union at removal. One patient had a posterior screw fixation and also skeletal traction (1 female). The symphysis plating and the Iliac plating was done with 3.5mm reconstruction plate. The external fixation was done with a uniplanar fixator with 2 schanz screws in each iliac wing connected as a rectangle. After six week all were started on physical therapy of hip and knee. The fracture

classification was obtained from the records and from radiological assessment. The injury severity scale was calculated from the available records.

Photographs of a Trapezoidal External Fixator

General Health Outcome survey, Majeed and Iowa pelvic score (see appendix) was administered during follow up.

The Iowa Pelvic score is a questionnaire concerning activities of daily living as they relate to sequelae of pelvic trauma. Scores can range from 0 (poor function) to 100 (Normal function) points.

Majeed score is again a numerical scoring system which takes into account simple activities like walking, sitting, standing, return to work and sexual intercourse. It allows comparison between early and late results and also between various methods of treatment.

The Short Form 36 survey is a standardizes health status survey that provides a comprehensive psychometrically sound and efficient way to measure outcome from the patient's point of view. The SF 36 survey is based on the evaluation of 8 health concepts. A transformed scale score of 0-100 is calculated for each of these health concepts. The sum of the 8 scores was recorded as the total score. The patients were scored according to the reply they have given in the questionnaire. In the interpretation of Short Form 36 General Health outcome survey, the meaning of low and high scores is tabulated in table 2.

Health Concept	Meaning of scores	
	Low	High
Physical functioning	Limited a lot in performing all physical activities including bathing or dressing.	Performs all types of activities including the most vigorous without limitations due to health
Role limitations due to physical problems	Problems with work or other daily activities as a result of physical health	No problems with work or other daily activities as a result of physical health during the past 4 weeks
Social functioning	Extreme and frequent interference with normal social activities due to physical and emotional problems	Performs normal social activities without interference due to physical or emotional problems.
Bodily pain	Very severe and extremely limiting pain	No pain or limitation due to pain
General mental health	Feeling of nervousness and depression at all times.	Feels peaceful , calm and happy all the time during the past 4 weeks
Role limitations due to emotional problems	Problems with work or other activities as a result of emotional problems	No problems with work or other daily activities as a result of emotional problems in the past 4 weeks
Vitality	Feels tired and worn out all the time	Feels full of pep and energy all the time during the past 4 weeks
General health perceptions	Thinks personal health is poor and likely to get worse	Thinks personal health is excellent

Table 2:

Mechanism of Injury:

Of the 23 patients (Table 3) the majority were due to Road Traffic accidents which included mainly

two wheeler Vs. four wheeler,

bicycle Vs 4 wheeler,

crushed under weights in an upturned vehicle, thrown away from a vehicle and tyre run over, followed by crushing injury which included mud wall collapse and bullock cart run over. Fall from height included fall into a well, and from a tree.

Table 3 Mechanism of injury

Tile Class	RTA		Fall from height		Crush	
	M	F	M	F	M	F
B	6	-	2	1	3	2
C	4	-	1	-	1	3

Analysis of Data:

The data were analyzed using Statistical Analysis software 9.1 and SPSS 11.0 and the following results were interpreted. During analysis of the data the median was taken into consideration. There was a small subgroup of patients who sustained severe associated injuries.

The sub group included two males with femur osteomyelitis, one male with tibial osteomyelitis, one post neck of femur non union surgery, and one refracture right humerus who have consistently given low scores in all the system of evaluation. These patients had better pelvic fracture results but had associated injury with delayed healing hence showing poor result.

From the data available the Median and the Inter Quartile Range is presented. The inter quartile range means the patients falling between the 25^{th} percentile to the 75^{th} percentile in the curve formed by the data.

Injury severity score:

The Injury Severity Score is a simple numerical method for grading and comparing injuries by severity. Although originally intended for use with vehicular injuries, its scope is increasingly expanded to include other injuries. It is a consensus-derived, anatomically based system of grading injuries on an ordinal scale ranging from 1 (minor injury) to 6 (lethal injury). (See appendix 2)

The average Injury severity score was 31.74 (16 – 80).

From the data available the Median and the Inter Quartile Range is presented (Table 4).

There were 3 patients who suffered massive injury, one undergoing amputation of the leg, one sustaining both tibia fracture and another both the lower and upper limb fractures. Their values fell outside the inter quartile range.

Among the 14 Tile B patients the median score was 20 and among the nine Tile C patients the median score was 41. The p value of the table is **p = 0.094**. The Inter quartile range for Tile B was 16 – 29 and Tile was C 16 – 52.

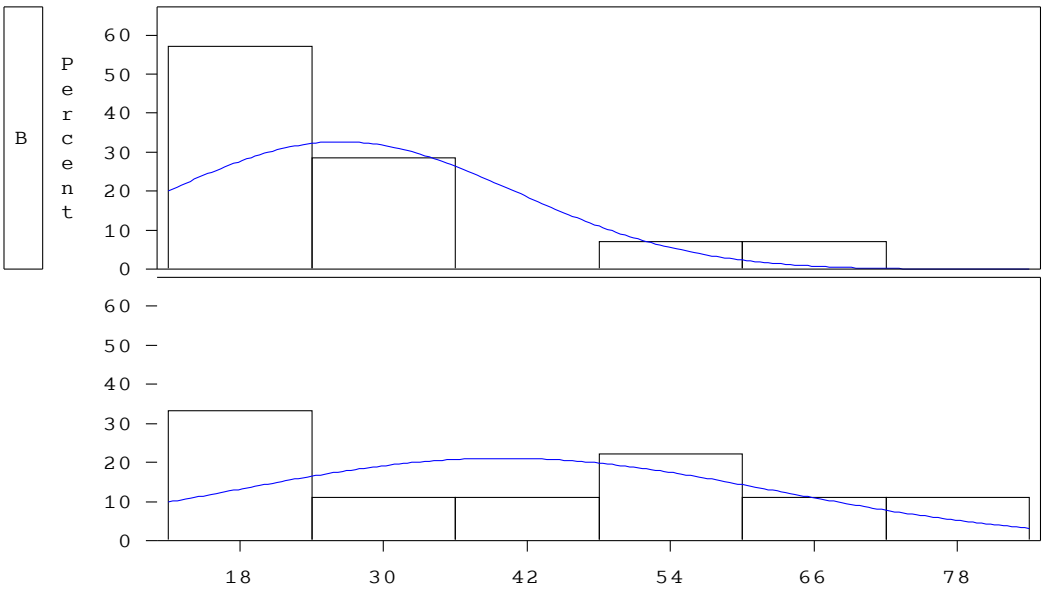
As evident from the data there is an increase in the Injury severity score in patients with Tile C injury. Though the P value fails to reach statistical significance, the less number of patient in the study needs to be considered. However majority of the patients (5 out of 9) who sustained Type C injury scored less than 40. Two

patients in the Tile B group scored above 50. One of the two sustained severe injury to the femur also.

A patient who had the maximum injury severity score which is 80, underwent external fixation of his pelvic fracture and above knee amputation

Table 4

Analysis Variable : ISS ISS					
Tile Type	N Obs	N	Median	25th Pctl	75th Pctl
B	14	14	20.0000000	16.0000000	29.0000000
C	9	9	41.0000000	16.0000000	52.0000000



The Majeed Scores:

The Majeed system assesses the functional outcome of the patient taking into account the daily activities, details of gait, aids used and sexual intercourse, and can be applied to see the progress of the patient at different periods. It is scored out of 100. The average score was 87.3%. (47 – 100). (Table 6)

The Median score and Inter quartile range for

Tile B was 99.5% (87 – 100) and Tile C was 83% (70 --100).

The Tile B patients scored better with a median of 99.5% with the patients falling between the 25th and the 75th percentile, that is the inter quartile range is 87 to 100. The Tile C patients scored a median of 83% with the range being 70 to 100. However the P value for Majeed scoring is p = 0.19 (Table 5)

The lowest score is from the patient who is the last to follow up in the study, who is now seven months post trauma, has had urethral surgery in June 2007 and comminuted Ilial fracture. He is undergoing treatment now. He was treated with upper tibial skeletal traction and bed rest for six weeks and partial weight bearing crutch walking for six more weeks.

He scored poorly in the sexual function as he complains of impotence, He is ambulant without support but cannot sit for a long time comfortably and cannot squat.

Table 5

Tile Type	N Obs	Variable	Label	N	Median	25th Pctl	75th Pctl
B	14	Majeed Iowa_100	Majeed Iowa 100	14 14	99.5000000 99.0000000	87.0000000 88.0000000	100.0000000 100.0000000
C	9	Majeed Iowa_100	Majeed Iowa 100	9 9	83.0000000 77.0000000	70.0000000 57.0000000	100.0000000 98.0000000

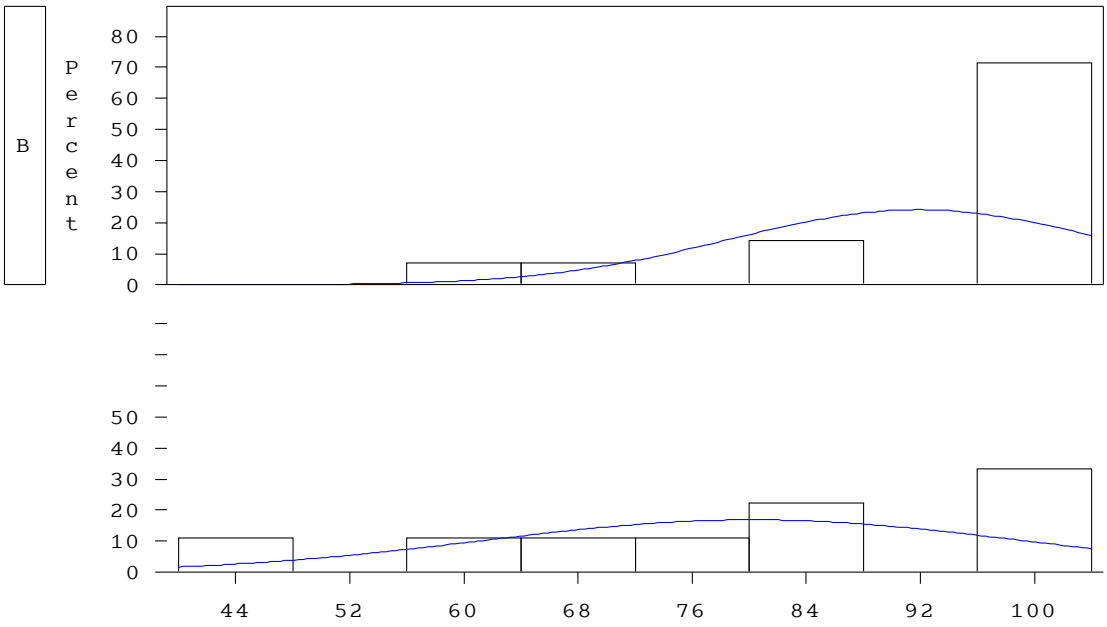


Table 6

The patient in the fair group includes one male who had undergone Valgus osteotomy of the femur for neck of femur non union, he is started on full weight bearing crutch walking now and is advised against squatting or sitting crossed leg. The others include a male who has chronic osteomyelitis of the femur and a lady of 51 years age who has low back pain on stooping. The former is disabled because he cannot bend his knee due to quadriceps fibrosis and the latter is able to do all activities but limited in household work like sweeping the floor and washing clothes, which she perceives as her major disability.

While evaluating the 'good' category one patient in the Tile B category scored as good, he was disabled to some extent due to the injury to his humerus requiring multiple surgeries and hence unable to return to work. Also the one

Majeed Grade	Tile B	Tile C
Excellent >85	11	4
Good 70-84	1	3
Fair 55-69	2	1
Poor <55	-	1

who sustained both tibia fracture is also unable to return to his same work. The patient who underwent above knee amputation is rated in the good category.

Seven patients in the Tile B group scored 100 and three in Tile C scored 100.

The girl who sustained a Tile C3 injury who underwent posterior sacroiliac screw fixation and skeletal traction scored 100. Her radiograph and photograph is presented in the adjacent page. She has no pain or disability. Clinical examination revealed no

shortening or posterior pelvic pain. The sacroiliac joint stress test was negative.

The man who underwent Ilial plating for Tile Type C injury also scored 100 and was able to return to active work at the same level of intensity.

The housewives and students were included in the working category for analysis. There were three women who were housewives. Two sustained type C injury and one type B injury. One in type C scored 100, however her follow up period was one of the longest (5 years).

Majeed Scoring System

Table I. System for functional assessment after pelvic fractures

Pain - 30 Points		
Intense, continuous at rest	0-5	☐
Intense with activity	10	
Tolerable, but limits activity	15	
With moderate activity, abolished by rest	20	
Mild, intermittent, normal activity	25	
Slight, occasional or no pain	30	
Work - 20 points		
No regular work	0-4	☐
Light work	8	☐
Change of job	12	☐
Same job, reduced performance	16	☐
Same job, same performance	20	☐
Sitting - 10 points		
Painful	0-4	☐
Painful if prolonged or awkward	6	☐
Uncomfortable	8	☐
Free	10	☐
Sexual intercourse - 4 points		
Painful	0-1	☐
Painful if prolonged or awkward	2	☐
Uncomfortable	3	☐
Free	4	☐
Standing – 36 points		
Walking aids (12)		
Bedridden or almost	0-2	☐
Wheelchair	4	☐
Two crutches	6	☐
Two sticks	8	☐
One stick	10	☐
No sticks	12	☐
Gait Unaided (12)		
Cannot walk or almost	0-2	☐
Shuffling small steps	4	☐
Gross limp	6	☐
Moderate limp	8	☐
Slight limp	10	☐
Normal	12	☐
Walking Distance (12)		
Bedridden or few metres	0-2	☐
Very limited time and distance	4	☐
Limited with sticks, difficult without prolonged standing possible	6	☐
One hour with a stick limited without	8	☐
One hour without sticks slight pain or limp	10	☐
Normal for age and general condition	12	☐

The Iowa Pelvic Score:

It is a numerical scoring system which utilizes data from daily activities such as standing in a queue, going to a movie, carrying a grocery bag, to ascertain performance in normal daily activity, work status, degree of pain using visual pain analogue and also stresses on patients perception of cosmetic change and ability to walk. It is scored out of 100. The average score was 86.04% (Table 7)

Presenting the Median and the Inter Quartile range

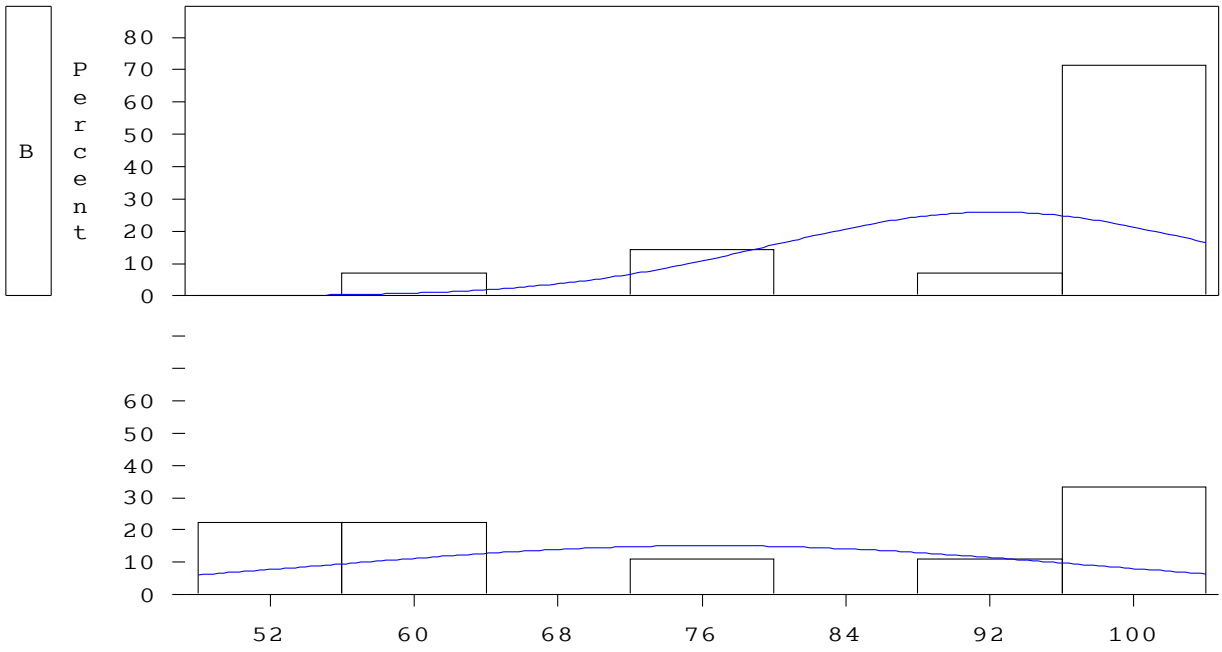
The patients in Tile B median scored a median of 99% with an Inter Quartile Range of 88 to 100 and the patients in Tile C scored a median of 77% with the range being 57 to 100.

Looking at the data, the patients in the Tile B arm had fared better, though calculating the statistical significance to see if there is a difference between the patients who sustained Tile B and C injuries, the P value was $p = 0.076$ showing the observation failed to reach statistical significance.

Six people in the Tile B group scored 100 and two in Tile C scored 100. Three people scored less than 60% and they all belonged to Tile C category.

Table 7

Tile Type	N Obs	Variable	Label	N	Median	25th Pctl	75th Pctl
B	14	Majeed Iowa_100	Majeed Iowa 100	14 14	99.5000000 99.0000000	87.0000000 88.0000000	100.0000000 100.0000000
C	9	Majeed Iowa_100	Majeed Iowa 100	9 9	83.0000000 77.0000000	70.0000000 57.0000000	100.0000000 98.0000000



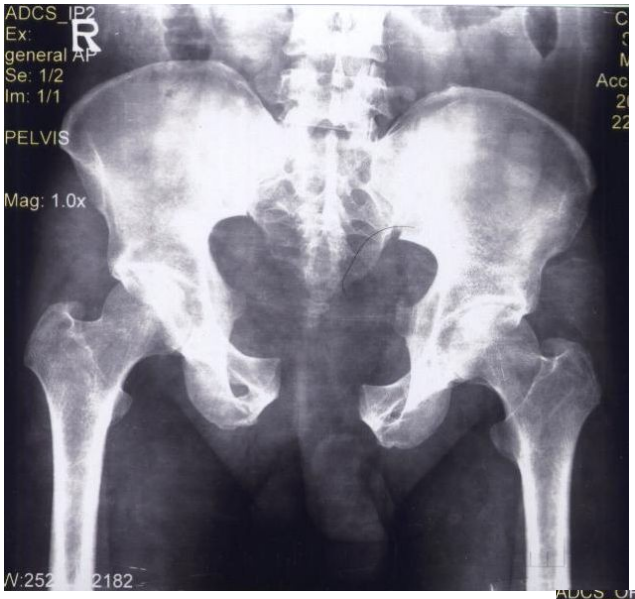
In the adjoining page is the photograph and radiograph of a patient who sustained a Tile type B injury when he was thrown out of a moving vehicle. He had a follow up of four and a half years. He gave consistently good scores, and scored 100 in this score too.

There were five patients who were unable to return to their previous job, which was a labourer, a driver, a businessman and two farmers. Three consistently gave low scores while one who underwent amputation was successful rehabilitated and changed to a sedentary job He scored in the good category.

The businessman scored poorly as he was unable to use his left upper limb due to refracture of the humerus and had to undergo repeat surgery, hence his activity of daily living was affected. He was treated with skeletal traction for his pelvic injury and clinical examination of his pelvic injury was normal.

Both the farmers continue to have posterior pelvic pain and were unable to return to their previous activity level and had difficulty in squatting. Their activities of daily living was hence affected.

The two who were partially disabled were both housewives. The two housewives scored poorly in the activities of daily living which included kneeling down, carrying a small child, and activities which involved stooping.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One of them showed lower scores in cosmesis, which was due to her colostomy and large perineal laceration. She underwent colostomy closure recently. She also had low score as she complained of inability to squat and climb stairs.

Iowa Pelvic Score:

Activities of Daily Living:

1. Walk 1 mile Yes/No
2. Stoop over a sink Yes/No

3. Carry a bag of groceries Yes/No
4. Make a bed Yes/No
5. Ride a car Yes/No
6. Sit for long periods (in a movie) Yes/No

7. Visit friends or relatives in an evening Yes/No
8. Stand for 1 hour or more (wait in a line) Yes/No
9. Rake leaves or mow a lawn Yes/No
10. Pick up a small child Yes/No
11. Sweep the floor with a broom Yes/No
12. Dress without assistance Yes/No
13. Cook a meal Yes/No
14. Light recreation (bowling/dancing) Yes/No
15. Vigorous recreation (jogging/tennis) Yes/No

16. Squat Yes/No
17. Walk up and down the stairs normally (foot over foot) Yes/No
18. Walk up and down the stairs with adjustment (stair at a time) Yes/No

19. Activities requiring reaching overhead Yes/No
20. Sleep comfortably Yes/No

Individual score:

Activities of daily living (20 points) --
1 point per question

Work History (points)
- No change (20) --
- Full time, change(15) --
- Part time, change (10) --
- Unable (5) --

Pain (points)
- None, not significant (25) --
- Occasional medication (20) --
- Regular medication (15) --
- Hospitalisation / Operation (5) --

Limp (points)
- None (20) --
- Yes (15) --

Appliance (10) --
Non ambulatory (5) --
Visual Pain Line (10 points) I----------I
0-No change 10-Unbearable
Cosmesis (5 points)
No significance
Significant change --

Associated Injuries:

While analyzing the patients who had sustained associated injuries, tables 8 and 9, the pattern of associated injuries is same among both the groups. But the number of associated injuries is comparatively more on the Tile C group (11 injuries in 9 patients) when comparing the Tile B group (13 injuries in 14 patients) considering the lesser number of patients in that arm, meaning that the patients had sustained multi system injuries.

In the Tile C group one underwent above knee amputation, one sustained elbow dislocation, radial styloid, spine and calcaneal fracture, one sustained fracture of both his tibia. The patients who complained of painful intercourse (3 patients) belonged to the Tile C group. One had urethral injury, the other suffered laceration around the genitalia with required a diversion colostomy and later treated with skin grafting as a second stage procedure.

The upper limb injuries were not serious enough to cause disability more than six weeks. One had refracture of the humerus, initially treated with orthofix external fixation and for the refracture treated with Ilizarov fixation.

The spine fractures were stable fractures. One was transverse process fracture and the other L1 stable fracture.

Table 8 Associated injuries

		Number
Ankle		2
Femur	Neck	1
	Subtrochanteric	1
	Intertrochanteric	1
	Distal	2
Tibia		1
Calcaneum		1
Foot		2
Vertebra		2
Soft tissue	Knee laceration	2
	Perineum	5
	Amputation of leg	1
	Forearm	1
Radius		2
Ulna		1
Humerus		3
Jaw		1
Urethral Injury		2

Table 9

Tile class	ISS	Urology	Upper limb	Lower limb	Spine*	Face	Perineum
B (14)	20	1	3	6	1	-	2
C (9)	41	1	2	5	1	1	1

ISS – Injury Severity Scale

* spine -- minor stable spine injuries

Three patients who sustained groin injuries were all treated with external fixation. Two required diversion colostomy for wound healing.

Of the two patients who sustained femoral fracture one developed chronic osteomyelitis and is under treatment now. The one who sustained both tibia fracture had an open fracture of the left tibia and had multiple surgical intervention for its treatment. He developed shortening of the leg and arthritis of the ipsilateral knee.

Mortality:

There were seven deaths among the patients admitted. Five sustained injury in a road traffic accident, one sustained crush injury when he was buried under a load of sand and the other was run over by a train. All were males of which three were documented to have severe pelvic bleed. One died due to acute liver failure and disseminated intra vascular coagulation. He had also sustained both femur fracture.

Among the seven patients four belonged to the Tile C group and three to Tile B group. Unrelated to this group one patient who was discharged, was readmitted with meningitis and succumbed to the infection.

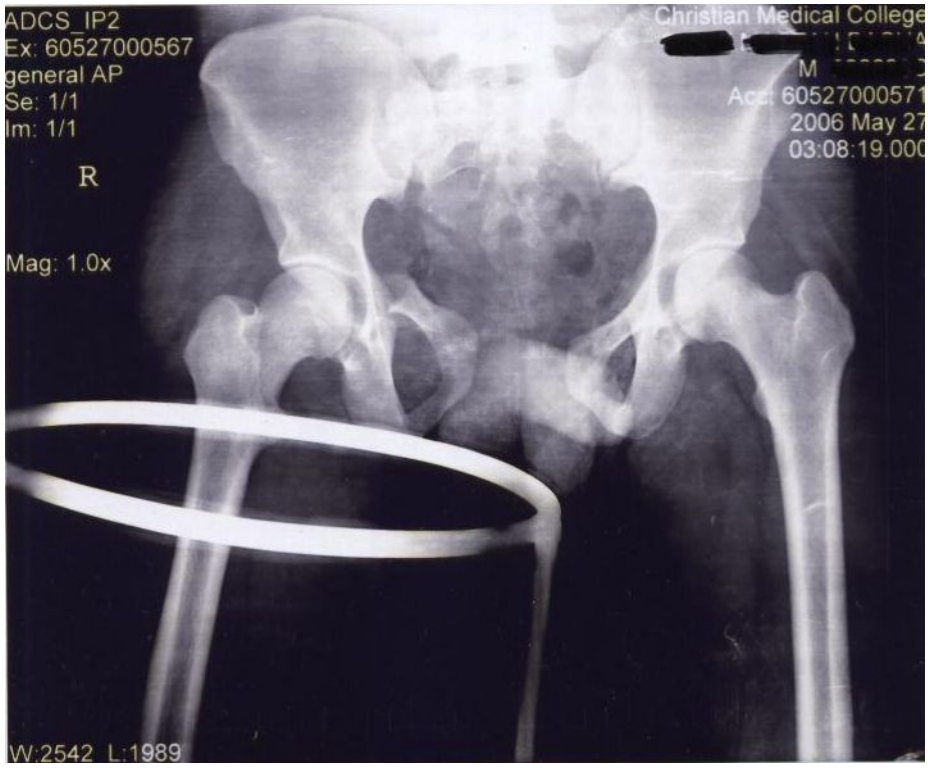
Work Status:

The number of people who returned to their original activity was significantly high (Table 10a & b). 15 out of 23 returned to their original activity. The five who had not returned to work were the ones mentioned earlier who belonged to the small subgroup who had developed osteomyeltis (3), refracture of the humerus (1), and seven months post operative patient (1).

Among the two housewives each belonged to either of the group and both of them were not able to work to their best capability, one is 11 months post injury and has had her colostomy closure surgery recently. She has difficulty in sitting for long periods and cant stoop or kneel down while sweeping the floor or washing clothes. The other is a 51 year old lady who complained of low back pain on stooping. Her main dissatisfaction is in being unable to do household work.

All the students recovered fully and returned to normal activities. One sustained Tile Type C injury in a lorry run over and recovered after surgery to return to her pre injury sporting and recreating activities. The other two sustained Tile type B injury. The person who had a change of job was the male who had above knee amputation and quit his driving job and changed to a sedentary job. He belonged to the Tile C group and was treated with external fixator. He was rehabilitated successfully and was

able to pursue an alternative vocation. His radiograph and photograph is attached in the adjoining page.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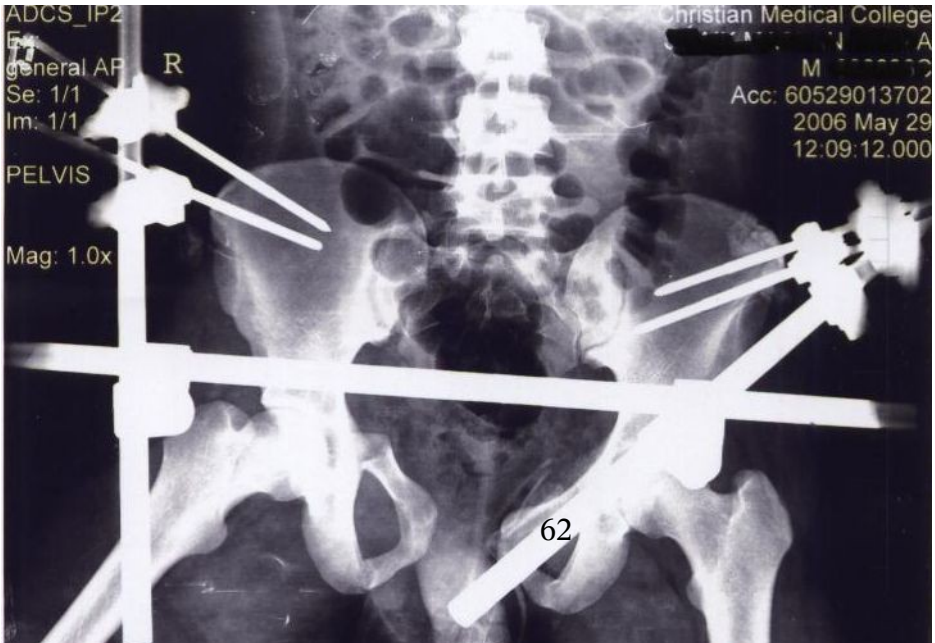
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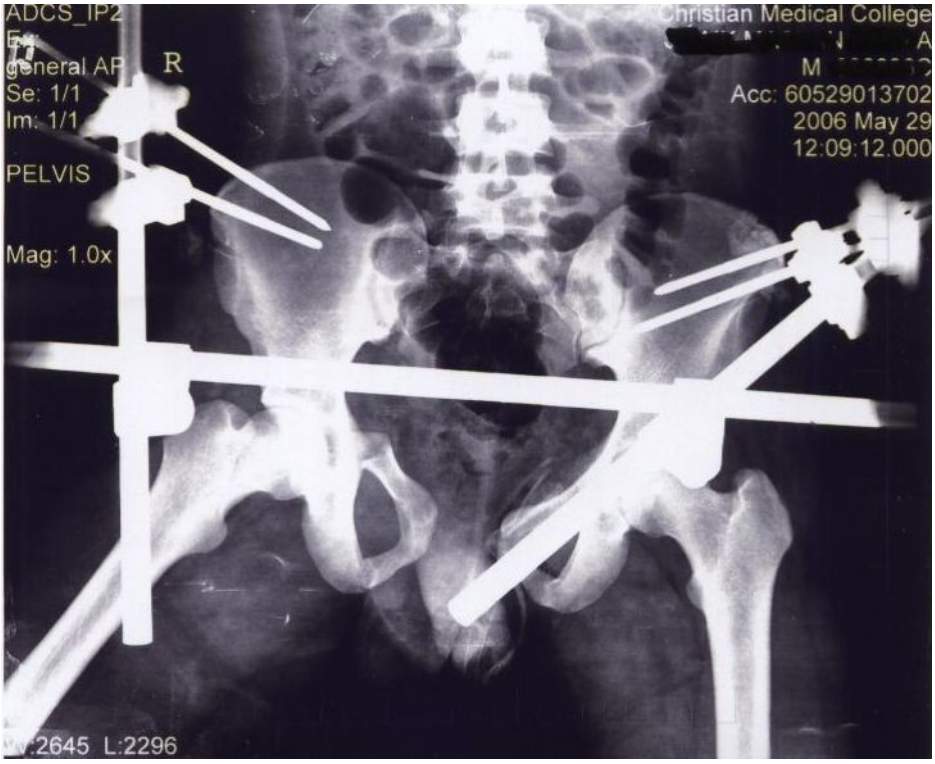
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with external fixator. He was rehabilitated successfully and was able to pursue an alternative vocation. His radiograph and photograph is attached in the adjoining page.

Table 10a: Work Status

Before Injury	Present	Number(%)
Employed Full time	Employed full time	10 (43.48)
Employed full time	Unemployed	5 (21.74)
Employed full time	Change of job	1 (4.34)
Student	Student	3 (13.04)
Home maker	HM normal work	2 (8.69)
Home maker	HM reduced work	2 (8.69)

Table 10b

	Original job	Change of Job	Disabled
Tile B 14	11	1	2
Tile C 9	4	2	3

Short Form 36:

The results of the survey is listed on the adjoining table 11. It deals with 8 health concepts and the patients perception of the transition of health from pre morbid condition to the time they had sustained the injury and to how they have improved.

Interestingly out of the 10 patients who have scored zero for 'Role limitations due to physical problems' only three were in Tile C category but four out of the seven in Tile B are in the small subset of five patients whose associated injuries were more significant than the pelvic disruption. The patients in Tile B averaged 95 against Tile C with 85 points.

The same could not be said for the 'Role limitations due to emotional problems' where the patients in the Tile C group did better though the analysis failed to reach statistical significance. Three patients scored zero one in Tile C and two in Tile B group. The two who score zero suffered severe financial burden due to the injury. The better score found in general may be due to the fact that the social and family support extended to the member of the family who has been injured. It had been the case of two women who were housewives and continues to have significant bodily pain but scored well in their social function and mental health.

Table 11: Short Form 36:

Health concept	Tile B	Tile C	P value
Physical functioning	95(68.75–100)	85(50-100)	0.693
Role limitations due to physical problems	12.5(0-100)	50(50-87.5)	0.506
Bodily Pain	89(67-100)	56(50-94.5)	0.131
General health	82.5(70-92.5)	80(72.5-92.5)	0.924
Vitality	75(75(60-90)	70(55-85)	0.658
Social Functioning	89(75-100)	89(56-100)	0.643
Role limitations due to emotional problems	83.5(33-100)	100(100-100)	0.102
Mental Health	90(71-93)	88(68-94)	0.702
Health Transition	75(75-100)	50(50-87.5)	0.096

With regards to ‘Bodily Pain’ the Tile B people had fared better, and also in terms of ‘General Health’ and ‘Vitality’. It would be obvious considering the fact that posterior ring disruption has a tendency to heal less desirably and leaves residual pain. None said that they were feeling irreversibly down hearted and blue, nor did they say that they felt worn out all the time.

Both the groups had no difference in ‘Social function’ which included going to meet friends or relatives, showing that the social and family support that is inherent to our culture, which exists as a good therapeutic agent in terms of mental health and emotional support.

Discussion:

The Tile Types B and C fractures are almost exclusively caused by high energy trauma. Road traffic accidents (RTA) are responsible in majority of the cases. Other mechanisms of injury are falls from a great height and local compression by high forces. Because of the mechanisms involved, a high percentage of the patients are multiply injured.

The grading scale may be useful in determining outcomes in patients who have pelvic fractures as their primary injury. However, a subgroup of 5 patients were identified in whom associated injuries affected the outcome more than their pelvic disruption.

These patients should be excluded when comparing the outcome between series.

Michael A. Miranda [26] in his follow up of 53 patients, he evaluated them using Iowa Pelvic Score and SF 36 health survey. He found that the patients in the Tile B category averaged 93 percent (60-100) and Tile C 84 percent (40-100) and that there was no difference in the percentage of those who returned to work between the categories. However residual effects as a sequelae of the injury showed higher percentage of people in the Tile C group continuing to have pain.

In a study conducted on the outcome after displaced sacral fractures by David Templeman [5] , the Iowa pelvic score averaged 87 points (48-100 points).

In this study, in the Iowa Pelvic Score, the patients in Tile B median scored a median of 99% with range of 88 to 100 and the patients in Tile C scored a median of 77% with the range being 57 to 100. The One sample t test done to compare the mean Iowa scores of this data with the previous study where Iowa score is 79, it is said that there is similarity with the p value being 0.714

While analysing the Majeed system the study done on 22 patients by Majeed [19] in 1990 showed excellent results were in 14 of Tile B and good in three patients. In Tile C, excellent result was in three and good in two patients respectively. In this series of 23

patients, in the Tile B group excellent result was seen in 11, good in one patient, and fair in two patients and in Tile C group excellent in four, good in three, fair and poor in one respectively. It showed Tile C patients were doing better than expected.

Certain activities that were evaluated in the SF-36 survey such as the ability to walk one mile or climb several flights of stairs, may not have any practical application to the patient who did not perform this activity before the injury. It is important to account for all the variations when assigning a quantitative score to the patient's activity level.

In the study Outcome after fixation of unstable posterior ring injuries, Dean J. Cole[6] assessed the outcome using Short Form 36 General Health Survey. Here he observed that various scores in the 8 health concepts, the lowest score was in the category 'role limitations due to physical problems' which averaged 47 points. Consistent low scores were also observed in 'bodily pain (53)and vitality (52)', 'general health perception (61) and physical functioning (61)' followed this. The 'social functioning' scored the highest (73) followed by 'general mental health' (67) and 'role limitation due to emotional problems' (65).

In this study 'role limitation due to emotional problem' showed the highest score (100) showing that even the patients who suffered major injuries did well in terms of emotional comfort,

who also showed good scores in ‘social functioning’ (89) and ‘mental health’ (88). The lowest scores was noted in ‘role limitation due to physical problem’ (50) and ‘bodily pain’ (56). General health averaged 80 points and vitality 70 points.

Although the SF-36 survey is effective in eliciting the patient’s perception of general disability, pain and emotional state the questionnaire is not specific to pelvic injuries.

Fallon et al[10] in his study of urological injuries in patients who had suffered pelvic fracture noted that 10-15 percent of his patients sustained injury to the genitourinary system. Neil et al [27] observed that 7% to 25% incidence of urinary tract injuries in pelvic ring disruptions and isolated urethral injury in 4%-14% of the patients. In this study 8.7% (2 patients) of the patients had sustained urethral injury requiring surgical repair. Both were males.

Erectile dysfunction after blunt trauma and posterior ring pelvic fracture was observed in a study by Dean J. Cole[6], which was about 30%. One patient (9% in Tile C) was observed in this study. However two other patients complained of painful intercourse as a result of their pelvic injury, both in the Tile C category.

One of the vital issues in determining the success of treatment was the patient’s ability to return to previous activities. Unfortunately it is difficult to quantify ability to work, perform

household activities, and engage in recreational activities. Some had fluctuating lifestyles or had limited work experience before their pelvic fracture e.g. students. In the study on outcome of displaced sacral fractures David Templeman[5] observed that sixteen (50%) of the thirty patients returned to full time work, performing the same type work as before the injury and six (30%) were disabled. Holdsworth[11] in his study of fifty patients, 50% of his patients with vertically unstable fractures returned to their original occupation. Tornetta[20] who treated his patients using internal fixation, reported 75% of his patients returning to work. Dean J. Cole in his study noted work was affected in 18 of his 52 patients (35%). Eleven (21%) were disabled. In this, among the Tile C patients, four (44%) out of nine returned to same active duty and three (30%) were disabled. Only Tile C type of injury was taken for comparing as the other study involved sacral and posterior ring fractures only.

Household activity status is difficult to ascertain because participation is variable before injury. Furthermore, many activities are dependent on the geographic region in which the patient lives. Therefore understanding the patients ability to perform certain tasks should be evaluated on an individual basis.

Recreational performance is another aspect that was difficult to examine because patient's memory of past performance may

not be accurate. And participation in sports and recreation may change after injury due to unrelated reasons such as new interest or new social contacts.

The associated injuries were higher in the patients with the Tile C group which also related to the patients who had died after admission.

Conclusion:

The scores in the Iowa pelvic score and Majeed grade which assess their ability to return to the activities of daily living, work and recreation showed that patients in the Tile B group had better functional outcome.

The patients in the Tile C group had higher morbidity with more number of associated and multi system injuries. The association to death could not be ascertained due to the small number of occurrence.

While evaluating the psychological and psychosomatic status there was significant difference when dealing with role limitation due to physical activities, and the presence of bodily pain which limits physical functioning, where the patients in the Tile B group did better.

With regards to role limitation due to emotional problems, general health perception and Vitality they showed similar capabilities.

Limitations:

There were some limitations to this study, one of them being the limited number of people who were available for follow up. This proved difficult when calculating statistics and proving significance.

With the available radiographs assessing some of the sacroiliac dislocation and posterior fractures was difficult.

Some patients were within a year of injury when called for follow up and hence their outcome assessed revealed a poor outcome which, after sufficient time, could have improved.

Some scoring was not specific to pelvic fracture assessment and highly subjective where the patient had to quantify how they felt. While answering Short Form 36 survey, even those who had similar injuries showed varied and different psychosomatic and psychological scores.

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Appendix:

Appendix 1:

Proforma:

Name
Age at incident
Sex
Occupation
Mode of incident: RTA ,
Fall from height,
Heavy object fall/crush
Others

Open / Closed injury:

Clinical signs: Crepitus
Compression distraction test
SI joint tenderness
Pubic Diastasis
Urethral bleed
Rectal Bleed

Symptoms: Back ache
Deformity
Shortening
Neurological deficit

Examination: Gait
Deformity
Tenderness
Limb length discrepancy
Neurological deficits

Other Systems: Urinary
Intestines
Vascular
Chest
Brain
Spinal Cord

Other Skeletal Injury: Femur
Tibia
Spine
Calcaneum
Others – upper limb

Treatment: Bed rest
Traction
Surgery
Binder

Other Surgeries: Femur
Tibia
Spine
Others – upper limb

Classification: Tile A/B/C

Duration of hospital stay:

Investigations: Pelvis Xray

Scoring Systems: Majeed
Iowa pelvic score
SF 36

Appendix 2:

Injury Severity Scale

Body Aches

Does the patient ache all over the body? (Y or N)	1
Does the patient have muscle ache or stiffness in the chest wall ? (Y or N)	1
Does the patient have muscle ache or stiffness over the abdomen? (Y or N)	1

Abrasions, Contusions, Lacerations

Does the patient have any minor lacerations, contusions and abrasions handled by simple closure? (Y or N)	1
Does the patient have an extensive contusion or abrasion? (Y or N)	2
Does the patient have a large laceration? (Y or N)	2
Does the patient have large lacerations involving more than 2 extremities? (Y or N)	3
Does the patient have an avulsion less than 3 inches wide? (Y or N)	2
Does the patient have a large avulsion 3 inches or more wide? (Y or N)	3
Does the patient have severe lacerations and/or avulsions with dangerous hemorrhage? (Y or N)	4

Burn Injuries

Does the patient have first degree burns? (Y or N)	1
percent of body surface area involved by second degree burns (enter from 0 to 100)	2 to 5
percent of body surface area involved by third degree burns (enter from 0 to 100)	2 to 5

Skull and Cerebral Injury

Is there cerebral injury with headache or dizziness but no loss of consciousness? (Y or N)	1
Is there a nondisplaced skull fracture? (Y or N)	2
Is there a compound skull fracture? (Y or N)	4
Is there a displaced closed skull fracture without unconsciousness or other signs of intracranial injury? (Y or N)	3
Is there cerebral injury with/without skull fracture, with less than 15 minutes unconsciousness, and no no post-traumatic amnesia? (Y or N)	2
Is there cerebral injury with or without skull fracture, with unconsciousness more than 15 minutes, without severe neurological signs, and with brief post-traumatic amnesia (less than 3 hours)? (Y or N)	3
Is there cerebral injury with or without skull fracture with unconsciousness of more than 15 minutes, with definite abnormal neurological signs, and with post-traumatic amnesia 3-12 hours? (Y or N)	4
Is there cerebral injury with or without skull fracture, with unconsciousness of more than 24 hours and with post-traumatic amnesia for more than 12 hours (Y or N)	5
Is there evidence of intracranial hemorrhage? (Y or N)	5
Are there signs of increased intra-cranial pressure (decreasing state of consciousness, bradycardia under 60, progressive rise in blood pressure, or progressive pupil inequality)? (Y or N)	5

Neck Spine Injury

Does the patient complain of whiplash injury without anatomical and radiological evidence of injury? (Y or N)	1
Does the patient have a severe whiplash injury with anatomical and radiologic evidence of injury? (Y or N)	2
Does the patient have a cervical spine fracture without cord damage? (Y or N)	3
Does the patient have cervical spine injury with quadraplegia? (Y or N)	5

Ocular Injury

Are there abrasions and contusions of ocular apparatus (lids, conjunctivae, cornea, uveal injuries)? (Y or N)	1
Are there vitreous or retinal hemorrhages? (Y or N)	1
Is there a laceration of the eye and appendages? (Y or N)	2
Does the patient have a retinal detachment? (Y or N)	2
Is there loss of an eye? (Y or N)	3
Does the patient have an avulsion of optic nerve? (Y or N)	3

Facial or Neck Trauma

Are there fractures and/or dislocation of teeth? (Y or N)	1
Are disfiguring facial, scalp or skin lacerations? (Y or N)	2
Are there undisplaced facial bone fractures or compound fracture of the nose? (Y or N)	2
Is there a displaced facial bone fracture or a facial fracture with antral or orbital involvement? (Y or N)	3
Is there trauma to mouth or neck with major airway obstruction? (Y or N)	5

Chest Wall Injury

Are there simple rib or sternal fractures?(Y or N)	2
Is there a major contusion of chest wall without hemothorax or pneumothorax or respiratory embarrassment? (Y or N)	2
Are there multiple rib fractures without respiratory embarrassment? (Y or N)	3
Is there rupture of the diaphragm? (Y or N)	3
Is there an open chest wound? (Y or N)	4
Is there flail chest? (Y or N)	4

Cardiac and Aorta Injuries

Is there myocardial contusion without circulatory embarrassment? (Y or N)	4
Are there pericardial injuries? (Y or N)	4
Is there a aortic laceration? (Y or N)	5
Is there myocardial rupture or contusion, with circulatory embarrassment? (Y or N)	5

Lung and Pleural Space

Is there a hemothorax? (Y or N)	3
Is there pneumothorax? (Y or N)	3
Is there a lung contusion? (Y or N)	3
Is there pneumomediastinum? (Y or N)	4
Is there myocardial contusion without circulatory embarrassment? (Y or N)	4
Are there chest injuries with major respiratory embarrassment (laceration of trachea, hemomediastinum, etc.)? (Y or N)	5

Abdominal Wall

Does the patient have a seat belt abrasion?(Y or N)	1
Does the patient have a major contusion of abdominal wall? (Y or N)	2

Abdominal Organ Injury

Is there contusion of abdominal organs? (Y or N)	3
Is there retroperitoneal hemorrhage? (Y or N)	3
Is there a minor laceration of intra-abdominal contents (to include ruptured spleen, kidney and injuries to tail of pancreas)? (Y or N)	4
Is there rupture, avulsion or severe laceration of intra-abdominal vessels or organs, except kidney, spleen or ureter? (Y or N)	5

Thoracic and Lumbar Spine Injury

Is there a thoracic or lumbar spine fracture without neurological involvement? (Y or N)	3
Is there a thoracic and/or lumbar spine fracture with paraplegia? (Y or N)	4

Injury to Genitourinary Tract

Is there an extraperitoneal bladder rupture? (Y or N)	3
Is there avulsion of a ureter? (Y or N)	3
Is there a laceration of the urethra? (Y or N)	3
Is there an intraperitoneal bladder rupture? (Y or N)	4
Is there avulsion of the genitals? (Y or N)	4

Injury to Major Bones and Joints

Does the patient show minor sprains and/or a simple fracture? (Y or N)	1
Are there undisplaced long bone or pelvic fractures? (Y or N)	2
Are there serious sprains of the major joints? (Y or N)	2
Does the patient have any displaced simple long bone fractures? (Y or N)	3
Is there a displaced pelvic fracture? (Y or N)	3
Is there dislocation of a major joint? (Y or N)	3
Are there any lacerations of the major nerves or vessels of the extremities? (Y or N)	3
Are there multiple closed long-bone fractures? (Y or N)	4
Is there an amputation of a limb? (Y or N)	4
Are there multiple open limb fractures? (Y or N)	5

Injury to Fingers and Toes

Are fingers or toes dislocated? (Y or N)	1
Are there compound fracture of fingers or toes? (Y or N)	2
Are there multiple hand or foot fractures? (Y or N)	3
Are there multiple amputations of toes or fingers? (Y or N)	3

The top score in each category is taken and out of them the top 3 scores is taken and they are squared and the 3 scores are added.

Interpretation	Results
maximum score for general injury	4
maximum score for head and neck injury	5
maximum score for chest injury	5
maximum score for abdominal injury	5
maximum score for extremity/pelvic injury	5
injury severity score	75
estimated mortality rate	100

Example:

Region	Injury	AIS	AIS^2
Head/Neck	Single cerebral contusion	3	9
Face	No injury	0	
Chest	Flail chest	4	16
Abdomen	1. Liver laceration 2. Completely shattered spleen	4 5	25
Extremity	Fractured femur	3	
External	No injury	0	
Injury Severity Score (ISS) = 50			

Appendix 3:

SF 36 Health Survey

1.In general would you say your health is (please tick one box)

- ☐ Excellent
- ☐ Very good
- ☐ Good
- ☐ Fair
- ☐ Poor

2.Compared to one year ago how would you rate your health in general now (tick one box)

- Much better than one year ago ☐
- Some what better than one year ago ☐
- About the same as one year ago ☐
- Somewhat worse than one year ago ☐
- Much worse than one year ago ☐

3.The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much. (please tick one number)

Activities	Yes limited a lot	A little	not at all
a) Vigorous activities such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b) Moderate activities such as moving a table, pushing a vacuum cleaner, bowling or playing golf	1	2	3
c) Lifting or carrying groceries	1	2	3
d) Climbing several flight of stairs	1	2	3
e) Climbing one flight of stairs	1	2	3
f) Bending, Kneeling or stooping	1	2	3
g) Walking more than a mile	1	2	3
h) Walking several blocks	1	2	3
i) Walking one block	1	2	3
j) Bathing or dressing yourself	1	2	3

4.During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?
Please circle one number

	Yes	No
a) Cut down on the amount of time you spent on work or other activities	1	2
b) Accomplish less than you would like	1	2
c) Were limited n the kind of work or other activities	1	2
d) Had difficulty performing the work or other activities (For e.g. took extra effort)	1	2

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (eg. Feeling depressed or anxious)?
Please circle one number

	Yes	No
a) Cut down on the amount of time you spent on work or other activities	1	2
b) Accomplish less than you would like	1	2
c) Didn't do work or other activities as carefully as usual	1	2

6.During the past 4 weeks to what extent has your physical health or emotional problems interfered with your normal social activities with the family, friends, neighbors, or groups?
Please tick one.

- Not at all ☐
- Slightly ☐
- ☐
- ☐
- ☐

Moderately
Quite a bit
Extremely

7.How much physical pain have you had in the past 4 weeks

None	☐
Very Mild	☐
Mild	☐
Moderate	☐
Severe	☐
Very severe	☐

8.During the past 4 weeks, how much did pain interfere with your normal work (including work both outside the house and housework)? Please tick one box

Not at all	☐
A little bit	☐
Moderately	☐
Quite a bit	☐
Extremely	☐

9.These questions are about how you feel and how things have been with you during the past 4 weeks. Please give the one answer closest to the way you have been feeling for each item.

Please circle one number in each line

	All the time	Most	A good bit	Some	A little	None
a) Did you feel full of life?	1	2	3	4	5	6
b) Have you been a very nervous person?	1	2	3	4	5	6
c) Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d) Have you felt calm and peaceful?	1	2	3	4	5	6
e) Did you have a lot of energy?	1	2	3	4	5	6
f) Have you felt downhearted and blue?	1	2	3	4	5	6
g) Did you feel worn out?	1	2	3	4	5	6
h) Have you been a happy person?	1	2	3	4	5	6
i) Did you feel tired?	1	2	3	4	5	6

10. During the past 4 weeks, how much of the time has your [physical health and emotional problems interfered with your social activities (like visiting friends, relatives etc) please tick one box.

All the time	☐
Most of the time	☐
Some of the time	☐
A little of the time	☐
None of the time	☐

11.How true or false is each of the following statements for you.

Please circle one number

a) I seem to get sick a little easier than other people
b) I am as healthy as anybody I know
c) I expect my health to get worse
d) My health is excellent

Definitely true	Mostly true	Don't Know	Mostly False	Definitely false
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5

Master Sheet: Sheet1:

Name	Iowa 100	Majeed	100	ISS 100	Physical Functioning (%)	Role functioning physical (%)
Annamalai	100	96	20	95	25	
Boopalan	63	62	25	5	0	
Chinamma	77	66	16	50	0	
Devaki	100	100	16	100	50	
GokulaLakshmi	100	100	20	100	100	
GopiGope	88	80	25	70	0	
Jagadish	100	100	20	100	100	
Krishna Reddy	57	47	29	45	0	
MaidulKhan	97	99	29	100	100	
Manickam	63	74	41	85	25	
Murugan	96	100	32	90	25	
Nakeeran	100	100	16	100	25	
Perumal	99	96	16	95	0	
Ravi.J	98	100	49	100	50	
Ravichandran	89	87	16	100	75	
Renu	99	100	64	85	0	
ShaikMastanBasha	77	83	80	85	0	
Shankar	100	100	16	100	100	
Soni Sharma	100	100	16	100	100	
SriRamulu Reddy	73	87	53	65	0	
UmaMaheswari	48	70	52	20	0	
Valarmathy	100	100	18	100	0	
Venkatesan	55	61	61	55	100	

Bodily pain	General health	Vitality	Social functioning	Role functioning emotional	Mental Health	Health transition
89	90	75	100	33	92	75
78	45	45	6	0	64	75
44	60	60	63	0	72	75
78	90	70	100	100	88	75
100	100	100	100	100	100	100
67	90	75	89	100	88	100
100	100	100	100	100	100	100
33	85	70	89	100	72	50
100	85	90	89	100	92	50
56	75	60	56	100	76	25
89	70	60	75	33	68	50
89	70	30	75	67	68	75
100	90	85	100	100	92	100
100	95	90	100	100	96	50
89	80	40	100	100	60	75
67	70	85	100	100	96	75
56	70	80	75	100	92	100
100	100	90	100	100	92	75
100	95	100	100	100	100	100
67	75	65	89	67	88	75
44	80	50	56	0	64	50
67	80	65	89	67	76	100
56	70	70	50	100	92	50

follow up period mths	Tile Type	MOI	MOI	Treatment of pelvic #	Change of prof
76	2	1	2wh vs 2wh	Bed rest	supdt
18	2	2	Fall off lorry	Ex Fix	nil
31	2	3	run over	Bed rest	hw partial
66	3	3	wall collapse	Bed rest	hw
27	2	3	wall collapse	Spica	student
21	2	1	2wh vs bus	Sk. Traction	Disabled due to humerus#
68	2	1	2wh vs lorry	Bed rest	student
9	3	1	4wh vs 4wh	Bed rest	nil
42	2	3	run over by a lorry	Bed rest	Electrician
29	3	1	thrown out of lorry	Bed rest	nil
46	2	3	lorr run over	Bed rest	Salesman
88	2	3	lorry upturned	Bed rest	Driver
37	2	1	fall from bus	Bed rest	Stone breaker
79	3	2	fall into well	Plate Ilium	Framer
56	3	3	bullock cart run over	Bed rest	Farmer
16	2	2	fall from tree	Sk. Traction	Teacher
17	3	1	2wh vs bus	Ex Fix	STD booth
43	2	1	Thrown out of lorry	PS plating	Asst Engg
23	3	3	cycle vs lorry	Post percut screw	Student
44	2	1	2wh vs bus	PS plating	Farmer
10	3	3	bus run over	Ex Fix	HW partial
60	2	2	fall into well	Bed rest	HW
78	3	1	cycle vs lorry	Bed rest	Disabled

Tile Type: 2 = Tile B; 3= Tile C

MOI – Mode of injury 1= Road Traffic Accident
2= Fall from Height
3= Crush

original prof	Associated injury	Additional surgery
supdt	Lat mall #	
farmer	R nof #, groin laceration	
hw		
hw		
student	R subtroch	
business	Open Humerus	Orthofix-Re #- Ilizarov
student	L Capitellum	
labourer	l radial styloid, urethral injury	Perineal urethroplasty
Electrician	Uretheral injury, knee laceration	SPC - perineal urethral plasty
driver	Foot Metatarsal #, Both bones both legs	L IM Nail, R Ilizarov+BG+BMI
salesman	perineal laceration	colostomy
Driver		
Stone breaker	L Groin laceration R Lat mall#, L Forearm degloving	Cast, STSG
farmer	R elbow disloc, # calcaneum, radius, spine tansverse process	Orif calcaneum,cast radius
farmer	R Intertroch # Undisplaced incomplete	
Teacher		
driver	Crush Right leg, Groin laceation, Jaw #	Colostomy,R AK Amputation
Asst Engg		
Student		
Farmer	Femur #, knee laceration	Ilizarov, BG, Qplasty
HW		
HW	L1 stable #	
Farmer	Femur #	IM Nail - Chr OM

Complaints
Reduced performance
SI joint pain
Pelvic pain limits activity

humerus# ununited

unable to have intercourse
Uncomfortable intercourse
Disabled, 1cm short R tibia

reduced job performance

Right Limb 1cm short, SI jt pain

Stiff arthritic knee
Painful intercourse, severe pelvic pain

Right femur Short 2 cm, Arthritis knee, R pelvic pain

Sheet 2:

Name	Occupation	Age	Sex	Hospita number	Date of incident	Mode of injury
Annamalai	Supdt	51	1	026874C	12.06.2001	1
Boobalan	cleaner	41	1	804439C	22.04.2006	2
Chinamma	HW	51	2	600725C	09.03.2005	3
Devaki	HW	26	2	147154C	24.04.2002	3
Gokula lakshmi K.A	Student	4	2	659271C	03.07.2005	3
Gopi Gope	Business	25	1	781582C	16.01.2006	1
Jagadish	student	17	1	130900C	26.02.2002	1
Krishna Reddy	Labourer	60	1	957386C	09.01.2007	1
Maidul Khan	Electrician	25	1	450125C	05.04.2004	3
Manickam. M	Driver	39	1	685289C	25.05.2005	1
Murugan	Salesman	47	1	400072C	26.12.2003	3
Nakeeran	Driver	26	1	894070B	02.06.0000	3
Perumal	Stone breaker	25	1	529621C	29.09.2004	1
Ravi	Farmer	45	1	993597B	10.03.2001	2
Ravichandran	Farmer	29	1	284939C	22.02.2003	3
Renu	Teacher	56	1	839193C	16.06.2006	2
Shaik Mastan Basha	driver	24	1	828026C	26.05.2006	1
Shankar	Asst Engg	38	1	445376C	27.03.2004	1
Soni Sharma	Student	20	2	741880C	23.11.2005	3
SriRamulu Reddy	farmer	39	1	421082C	04.02.2004	1
Uma Maheswari	HW	25	2	950418C	23.12.2006	3
Valarmathi	Labourer	19	2	209544C	15.10.2002	2
Venkatesan	labourer	29	1	008644C	03.04.2001	1

Sex 1= male; 2= female.

Clinical signs	Open or closed	crepitus	Compression distraction test	S.I. Joint tenderness	Diastasis of pubic symphysis
	2	2	1	2	1
1	1	1	1	2	2
0	2	2	1	1	2
0	2	1	1	1	2
0	2	2	1	2	2
0	2	2	1	1	2
0	2	1	2	2	2
0	2	1	1	2	2
0	2	2	1	1	1
0	2	1	1	1	2
1	1	1	1	1	2
0	2	2	2	2	2
0	1	2	1	1	2
0	2	2	1	1	2
1	2	1	1	1	2
0	2	2	1	2	2
1	2	1	1	1	1
0	2	2	1	2	1
0	2	1	1	1	1
0	2	2	1	2	1
1	1	2	1	1	1
0	2	2	1	1	2
0	2	2	1	2	1

Clinical Signs: 1= Ecchymosis,
Open or Closed: 1= Open; 2= Closed
Crepitus, Compression distraction, SI Joint tenderness, Diastasis Pubis: 1= Present ; 2= Absent

uretheral bleed	rectal bleed	other systems injuries	Other Orthopaedic injuries	Treatment
2	2	0	0	4
2	1	0	1	3
2	2	2	0	1
2	2	0	0	1
2	2	0	1	1
2	2	0	5	2
2	2	0	0	1
1	2	1	5	2
1	2	0	0	1
2	2	0	2,5	1
1	1	1	0	1
2	2	0	0	1
2	2	2	2	1
2	2	0	4,5	3
2	2	0	1	1
2	2	0	0	1
2	2	0	1	3
2	2	0	0	3
2	2	0	0	2,3
2	2	0	1	3
2	1	2	6	3
2	2	6	0	1
2	2	0	1	1

Urethral Bleed, Rectal bleed: 1= Present; 2= Absent

Other system injuries: 0 = none,1= Urinary, 2= Intestines,
3= Vascular, 4= Chest , 5= Brain,
6= Spinal Cord

Other Orthopedic Injury: 0= none,1= Femur, 2= Tibia
3= Spine, 4= Calcaneum,
5= Others – upper limb

Treatment: 1= Bed rest, 2= Traction, 3= Surgery
4= Binder

Other surgeries	Classification

0	2	PS Diastasis amd bilateral SI joint opening
		Fall off alorry, perineal laceration and exposed testes, R Ilium, L SI Ra
0	2	Exfix 3/12, R NOF
0	2	L SI joint disruption, L Iliac wing #, L SI rami #
0	3	L SI rami, R I rami, Sacral # L
0	2	R SI rami #, R SI joint diastasis, R Sub Troch #
5	2	PS diastasis, L si joint, L I rami, SK tration 3 months
0	2	R SI rami #, L I Rami#, R SI joint subluxation
0	3	L Radial styloid #-cast, B/L SI rami, R ilium Shattered - Traction
0	2	PS Diastasis, L I Rami #, R Sacral ala # L Knee laceration, Lorry run o
3	3	B/L SI Rami, R Sacral ala, Both tibia, R Foot Metatarsal
5	2	Run over by lorry Bilateral SI pubic rami L.C Type
0	2	lorry upturned, bilateral SI rami #
0	2	L SI rami, L si joint diastasis, L groin laceration, R lat malleolus # Cast
		Posterolateral dislocation of right elbow(CR) Right ilium # PS diastasis
5	3	right calcaneal # (ORIF ReconPlate) Right L234 transverse process #
		Run over by bullock cart, Left S,I rami #, PS Diastasis, R sacrum #, R
0	3	joint disruption
		fall from tree, open left BB FA- Rad exfix, Rush nail ulna, L Ilium,
0	2	undisplac Acetab, Traction
		Open Book, R S rami, R SI joint diastasis, Exfix, 3/12 Colostomy 5/12
5	3	bilateral groin laceration
0	2	RTA Orif symphysis
		hit by a lorry thrown onto rocks, BL SI Rami L ilum, undisp central # L
0	3	Acetab, BL SI joint diastasis
		Pubic diastasis, ORIF Recon Plate, R Distal femur #, R Popliteal
1	2	laceration,
		bus run over, APC type III, L sacrum, R II III MTB disloc, Degloving gro
5	3	left foot, Kwire foot, loop colostomy Ex fix pelvis
		fall into a well, L si rami, L sacral #, L SI joint, L1 lateral vertebreal
0	2	compression #
1	3	Lower third femur # Malgaigne #, Right iliac wing and PS diastasis

Other Surgeries: 1= Femur, 2= Tibia, 3= Spine
4= Others – upper limb

Classification: 2= Tile B; 3= Tile C